PB82-157777

Draft Environmental Impact Statement and Report North Monterey County Facilities Plan

Monterey Peninsula Water Pollution Control
Agency, CA

Prepared for

Environmental Protection Agency
San Francisco, CA

Apr 77

U.S. Department of Commerce
National Technical Information Service
NTIS

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Apr 77

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Grant EPA-C-06-1066

SPONSOR: Environmental Protection Agency, San Francisco, CA. Region IX.

Prepared in cooperation with Jones and Stokes Associates, Inc., Sacramento, CA. Errata sheet inserted. See also Volume 1, PB82-157785.Portions of this document are not fully legible.

The report describes a program which would provide additional waste treatment capacity at a consolidated regional facility to handle the expected growth in the North Monterey County area. The project would provide an acceptable method for the disposal of the treated wastewater resulting from the regional facility. The method of disposal should include re-use of this effluent through irrigation. When re-use is not possible, the effluent would be discharged either to the ocean (deep water) or the lower Salinas River through an outfall.

KEYWORDS: *Sewage treatment, *Environmental impact statements - draft, *Sewage treatment plants.

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Draft Environmental Impact Statement and Report

North Monterey County Facilities Plan

April 1977

U.S. Environmental Protection Agency

Monterey Peninsula Water Pollution Control Agency

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NORTH MONTEREY COUNTY FACILITIES PLAN
EIS/EIR

Errata Sheet

Subsequent to initiating printing of this document, Jones & Stokes Associates staff discovered several errors in population calculations shown in Table 46 on page 296. These numbers were used in projecting future air emissions and air quality in the Monterey area. Because we feel these calculations may be of significance in evaluating the potential secondary impacts of the proposed North Monterey County Facilities Plan, a brief addendum is being prepared to reflect the corrected population numbers and air quality calculations. As soon as this material is prepared, it will be forwarded to all recipients of the Draft EIS/EIR. This should be accomplished well before the public hearings on the document.

We sincerely regret any inconvenience this change in information may cause.

This addendum appears on page 379 of vol. I of the Final EIS on this project.

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
AND
ENVIRONMENTAL IMPACT REPORT

NORTH MONTEREY COUNTY FACILITIES PLAN

APRIL 1977

PREPARED BY

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The report [illegible]

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REGION IX
100 CALIFORNIA STREET
SAN FRANCISCO, CALIFORNIA 94111

April 8, 1977

To All Interested Agencies, Public Groups, and Concerned Individuals:

The Draft Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) for the North Monterey County Wastewater Facilities Plan is being distributed at this time for your review and comment. This program would provide additional waste treatment capacity at a consolidated regional facility to handle the expected growth in the North Monterey County area. The project would provide an acceptable method for the disposal of the treated wastewater resulting from the regional facility. The method of disposal should include re-use of this effluent through irrigation. When re-use is not possible, the effluent would be discharged either to the ocean (deep water) or the lower Salinas River through an outfall. The Draft EIS/EIR has been prepared to conform with the requirements of the National Environmental Policy Act of 1969 and the California Environmental Quality Act of 1970.

Comments on the Draft EIS/EIR should be sent to this Office within 45 days of the date of this letter. All comments received will be considered in preparation of the Final EIS/EIR for this action.

In order to receive testimony from the public, EPA will hold public hearings on the Draft EIS/EIR on May 18, 1977, at 7:30 P.M. at the following address:

Monterey City Library, Conference Room
625 Pacific
Monterey, California 93940

and on May 19, 1977, at 7:30 P.M. at the following address:

City Council Chambers
City Hall
Salinas, California 93901

The hearing may be continued from time to time, or to a different place, after its commencement, to accommodate the need of witnesses or the EPA.

All interested parties are invited to express their views at this hearing. Persons wishing to make comments may submit them in writing and/or appear at the hearing. Written comments should be submitted in triplicate to:

U.S. Environmental Protection Agency
Region IX
Attn: Hearing Office
100 California Street
San Francisco CA 94111

Oral statements will be received and considered, but, for accuracy of the record, all important testimony should be submitted in writing. Oral statements should summarize extensive written materials so that there will be time for all interested persons to be heard. Enough copies of the written materials should be produced so that other interested persons may receive a copy and there will be no necessity for written materials to be read at length.

The Draft EIS/EIR may be reviewed at the following locations:

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Please bring this notice to the attention of all persons who would be interested in this matter.

Sincerely,

Paul De Falco, Jr.
Regional Administrator

NORTH MONTEREY COUNTY FACILITIES PLAN EIS/EIR

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REPORT SUMMARY

Purpose and Objectives of the Project

The North Monterey County Facilities Plan is designed to improve water quality by improving *wastewater** treatment service to residents in the southern Monterey Bay-lower Salinas Valley region of Monterey County, California. This includes residents in the Cities of Monterey, Salinas, Seaside, Marina, Pacific Grove, Sand City and Del Rey Oaks; the unincorporated communities of Castroville and Moss Landing; and the Ft. Ord Military Reservation. The major objective of the project is to eliminate public health hazards and water quality problems being caused by existing wastewater discharges to Monterey Bay, the Salinas River, Tembladero *Slough* and Elkhorn Slough. In addition, the plan seeks to supply the additional wastewater treatment capacity needed to accommodate anticipated growth in the area and at the same time supply treated wastewater for irrigation reuse in the Castroville area so that overdrafting of the *groundwater* table and related salt water intrusion problems can be curtailed.

The Facilities Plan Draft Environmental Impact Statement (*EIS*) is a required element of the Monterey County Water Pollution Control Agency (MPWPCA) application for project funding under the joint federal-state financed Clean Water Grant Program. This program is administered by the California State Water Resources Control Board (SWRCB), but requires approval of the United States Environmental Protection Agency (EPA). Under terms of this program, local facilities construction projects are eligible to receive up to 75 percent federal and 12½ percent state grants for the planning, design and construction of municipal wastewater treatment systems. The minimum local share of the cost is therefore 12½ percent. The EIS must identify the potential environmental impacts of implementing the proposed project and its viable alternatives so that environmental as well as social and economic costs can be included in a *cost effectiveness* analysis of the plan.

Project Environmental Setting

The project study area encompasses 332 square miles of northern Monterey County from Elkhorn Slough on the north to Mt. Toro in the Sierra de Salinas Mountains on the south; and from the Gabilan Range on the east to Monterey Bay on the west (see Figure 1). This includes the fertile lower Salinas Valley, the rolling dunelands of Ft. Ord, the hilly Castroville-Prunedale and Monterey-Salinas corridors and the coastal urban areas along southern Monterey Bay.

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* Italicized words are defined in the Glossary.

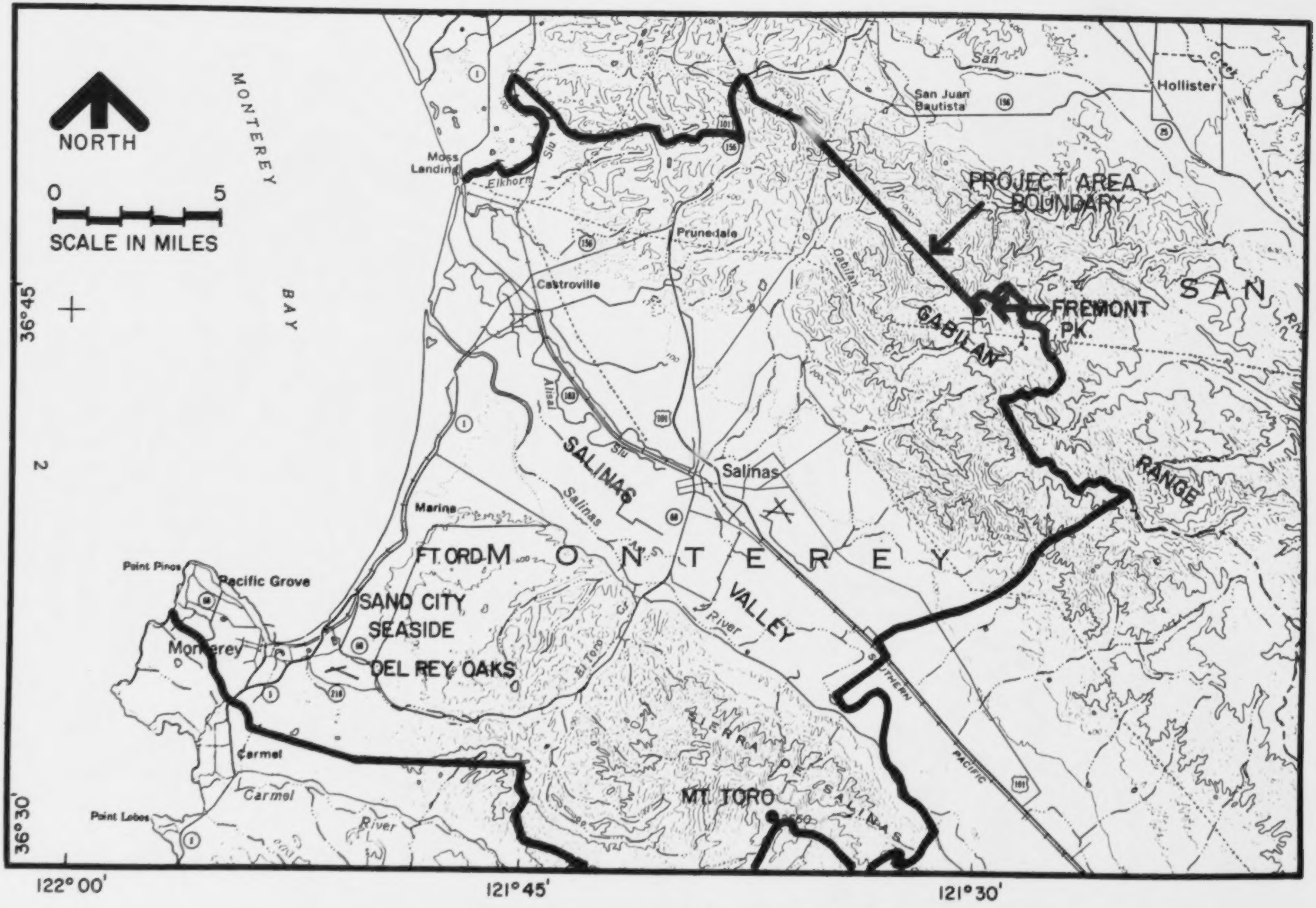


FIGURE 1 REGIONAL TOPOGRAPHY

Source: USGS 1:250,000 San Francisco Bay Region Map (7.5' series maps: Moss Landing, Prunedale, San Juan Bautista, Hollister, Mt. Harlan, Natividad, Chualar, Rana Creek, Spreckels, Seaside, Monterey, Marina, Salinas).

The principal land uses in the area are: agriculture and urban in the Salinas Valley; agriculture, grazing, rural residential and military in the rolling hills and dunelands between the valley and the coast; grazing and open space in the Gabilan Range foothills; and urban residential, commercial, recreation and military along the coast. There are small amounts of industry in the Salinas and Castroville-Moss Landing areas.

Agriculture and tourism are two of the major income-producers in the study area. Soils and climatic conditions make the lower Salinas Valley well suited to agricultural production. Monterey County as a whole accounts for slightly less than 3 percent of the state's harvested cropland, and slightly less than 3 percent of the state's total crop value. The majority of crops produced in the county are vegetables, sweet corn and melons, which historically account for about half the acreage in crops and about 18 percent of total California acreage in those crops; crops grown for grain account for another quarter of the acreage. Vegetable crops in the lower Salinas Valley, in order of diminishing value of production, are lettuce, celery, broccoli, cauliflower and artichokes. (Long-term trends in types of crops, irrigated acreage and value of crops are discussed on page   of the EIS). These crops are grown on some of the richest agricultural land in either the state or the nation, and they supply a nationwide market. While agriculture dominates the economy of the lower Salinas Valley, tourism is critical to the Monterey Peninsula. Its unique and historic attractions make this area one of the most popular vacation spots on the California coast.

The major surface waters in the study area are Monterey Bay, the Salinas River, Old Salinas River and Moro Cojo, Tembladero and Elkhorn Sloughs. These waterways and the major agricultural drains that feed into them (Main Reclamation Ditch and Blanco Drain) experience frequent periods of poor water quality due to discharge of *domestic wastewater* and agricultural *irrigation return flows*. Hazardous conditions for water contact recreation and shellfish harvesting frequently occur on coastal beaches and in the Elkhorn Slough-Moss Landing Harbor area.

There are currently eight major domestic wastewater discharges to the area's surface waters (see Figure 2). Of these, three are to surface streams (two into the Salinas River and one into Tembladero Slough) and five are to southern Monterey Bay. The low summer flows in surface streams and sluggish circulation in the near-shore waters of southern Monterey Bay have intensified the problems associated with existing waste discharges. As a result of these conditions and waste treatment requirements included in the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), existing discharges can no longer meet the Central Coastal Regional Water Quality Control Board (RWQCB) discharge requirements.

The California Department of Finance estimated that there were 166,819 people within the proposed project service area in 1975 (191,113 if Ft. Ord on-base housed personnel are included); by 1990 the local planning departments estimate the population will increase to 243,600 (263,600 with Ft. Ord). This population must be serviced by new wastewater facilities in order to remove the adverse water quality and public health conditions existing in surface waters today.

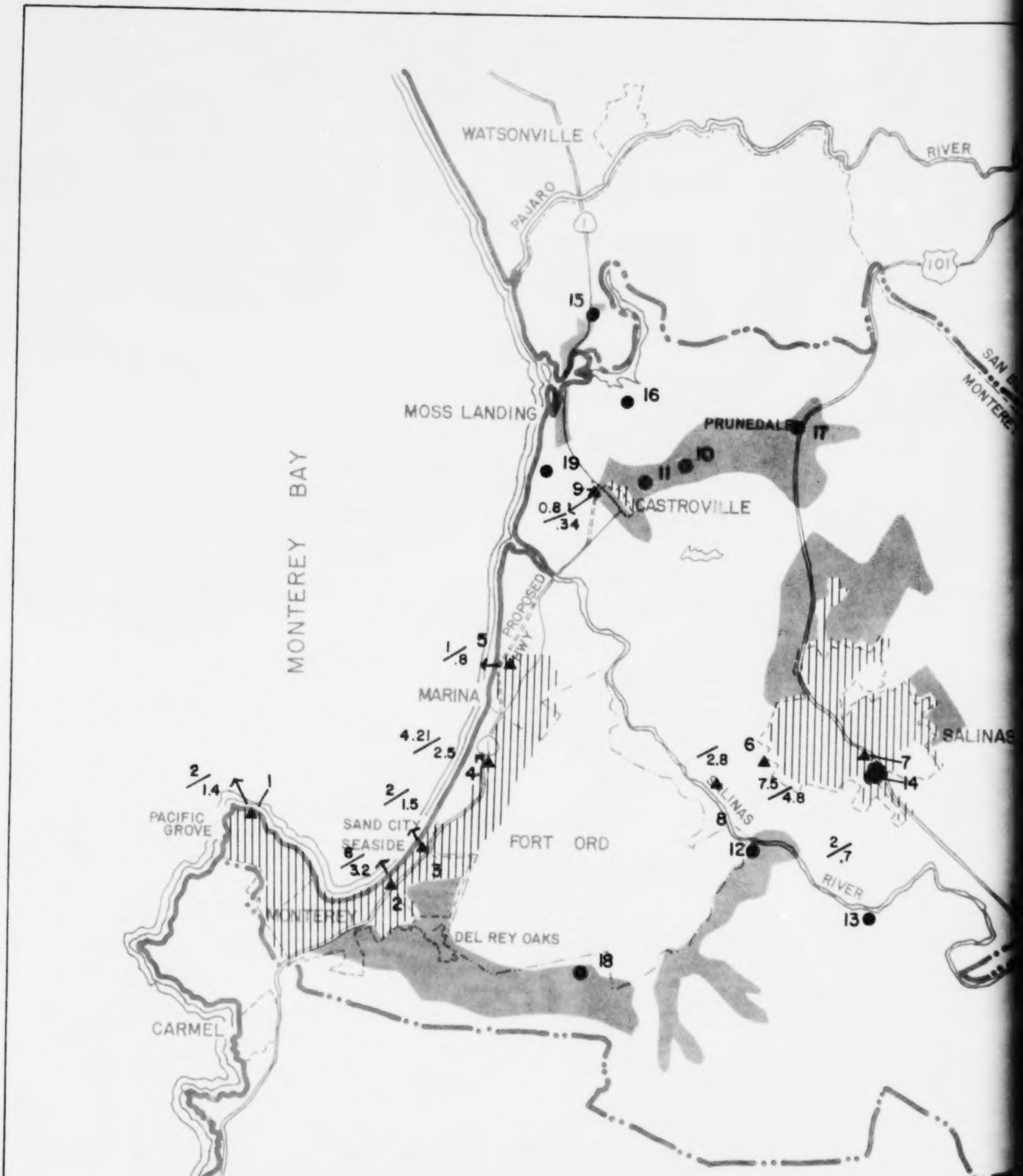
Legal, Regulatory and Institutional Constraints

Development of new wastewater facilities is affected by a variety of government agencies and their legal and regulatory mandates. Chief among these are pollution control mandates of the FWPCA and the California Porter-Cologne Act. The requirements of these acts are being implemented by the EPA and the SWRCB. In order to meet the requirements and receive federal-state funding for new facilities, MPWPCA must develop a plan that conforms to the objectives established in the Water Quality Control Plan - Central Coastal Basin. The major recommendations of this "Basin Plan" are elimination of south Monterey Bay waste discharges and regionalization of the area's waste treatment.

Waste discharge requirements issued by the RWQCB and the planning policies of Monterey County and the California Coastal Zone Conservation Commission are also major influences on development of the facilities plan.

Project Alternatives

Five major project alternatives (Figures 3, 4 and 5) and the required "no action" alternative are analyzed in detail in the EIS. The five alternatives were selected from an original list of 173 developed by Engineering Science, Inc., The Facilities Plan engineers. The alternatives reduction process included environmental, economic and engineering analyses of each plan; all assumptions used in the elimination process were presented for review and comment to the MPWPCA Technical Advisory Committee (TAC) which is composed of federal, state, regional and local government representatives and project consultants. The TAC was formed to guide the planning process


WATSONVILLE
PAJARO
RIVER
1
101
SAN B
MONTERE
15
16
MOSS LANDING
PRUNEDALE
17
10
11
19
9
CASTROVILLE
0.8 L / .34
MONTEREY BAY
PROPOSED HWY
1/.8
5
MARINA
4.21/2.5
4
2/1.4
1
PACIFIC GROVE
2/1.5
SAND CITY
SEASIDE
6/3.2
2
3
FORT ORD
MONTEREY
DEL REY OAKS
18
CARMEL
2.8
6
7.5/4.8
7
14
SALINAS
8
SALINAS
RIVER
12
2/.7
13

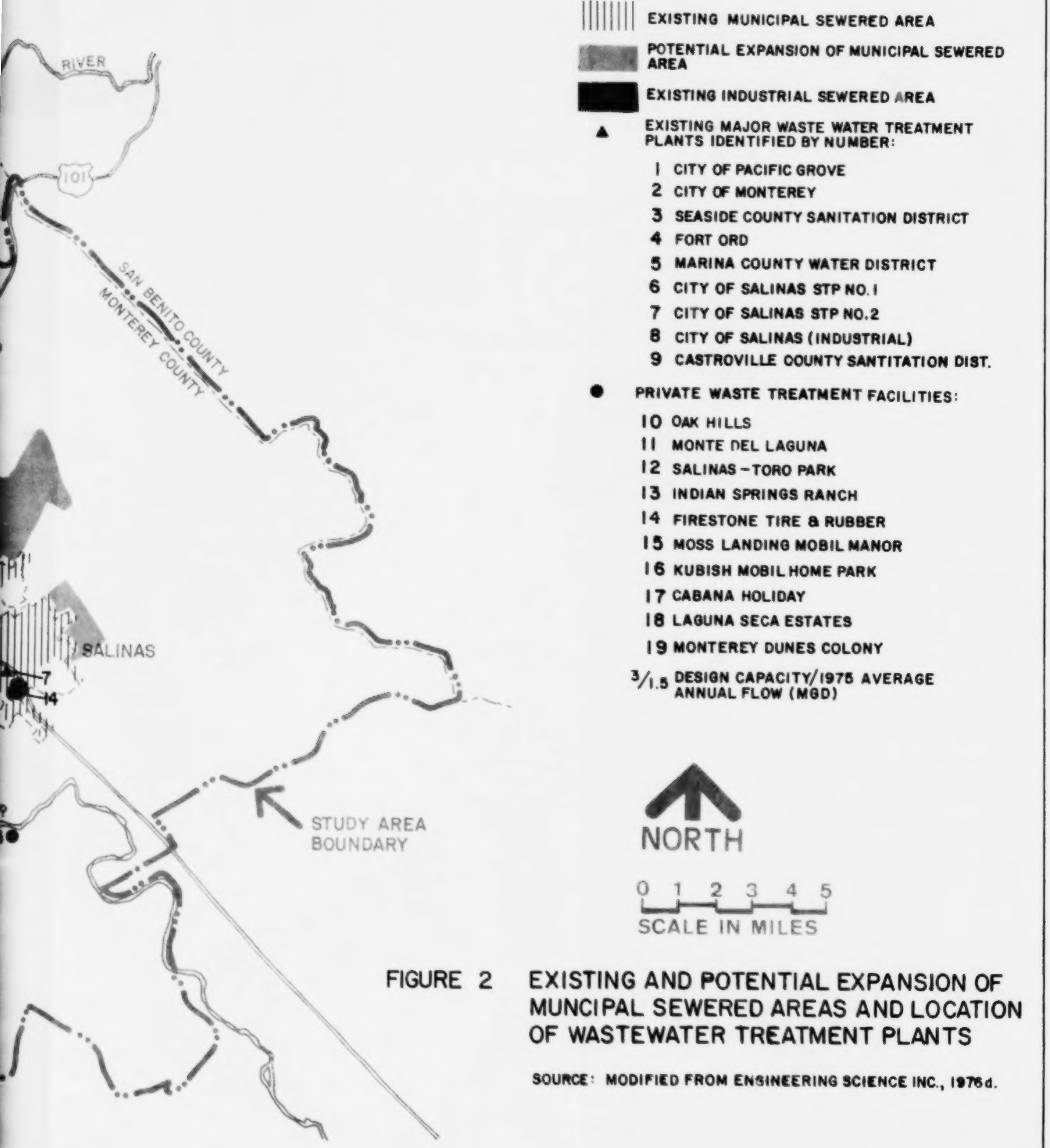
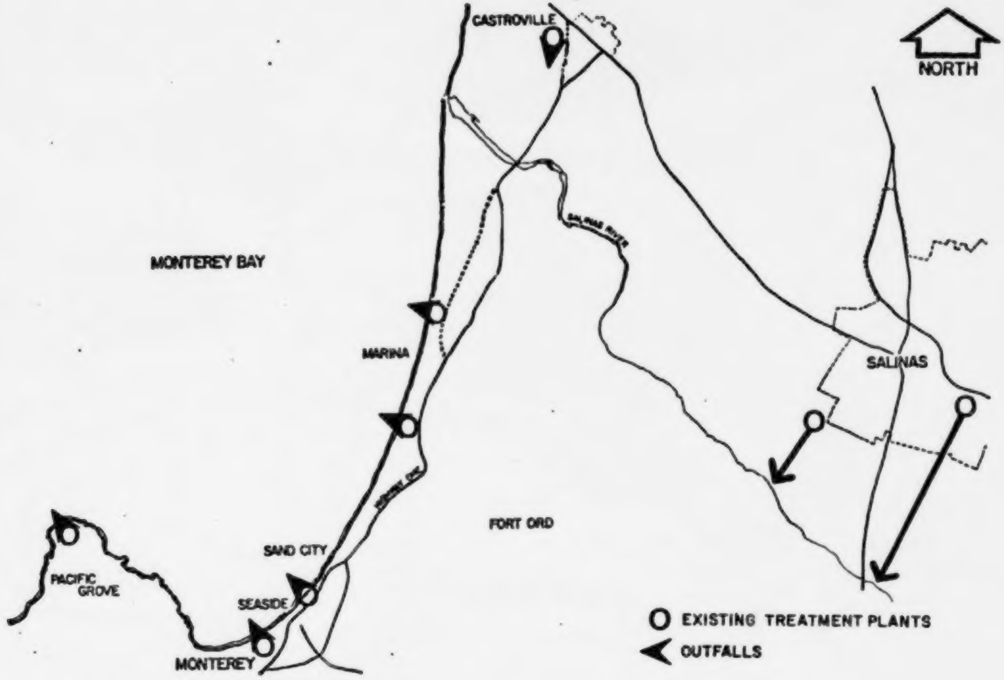
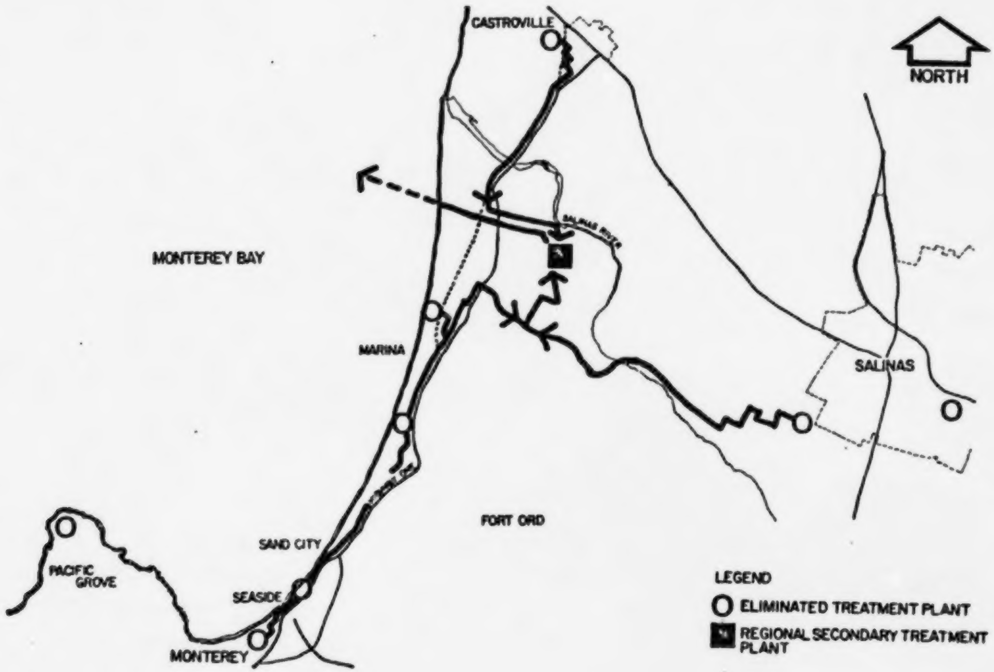

EXISTING MUNICIPAL SEWERED AREA
POTENTIAL EXPANSION OF MUNICIPAL SEWERED AREA
EXISTING INDUSTRIAL SEWERED AREA
▲ EXISTING MAJOR WASTE WATER TREATMENT PLANTS IDENTIFIED BY NUMBER:
1 CITY OF PACIFIC GROVE
2 CITY OF MONTEREY
3 SEASIDE COUNTY SANITATION DISTRICT
4 FORT ORD
5 MARINA COUNTY WATER DISTRICT
6 CITY OF SALINAS STP NO. I
7 CITY OF SALINAS STP NO. 2
8 CITY OF SALINAS (INDUSTRIAL)
9 CASTROVILLE COUNTY SANTITATION DIST.
● PRIVATE WASTE TREATMENT FACILITIES:
10 OAK HILLS
11 MONTE DEL LAGUNA
12 SALINAS-TORO PARK
13 INDIAN SPRINGS RANCH
14 FIRESTONE TIRE & RUBBER
15 MOSS LANDING MOBIL MANOR
16 KUBISH MOBIL HOME PARK
17 CABANA HOLIDAY
18 LAGUNA SECA ESTATES
19 MONTEREY DUNES COLONY
3/1.5 DESIGN CAPACITY/1975 AVERAGE ANNUAL FLOW (MGD)
RIVER
101
SAN BENITO COUNTY
MONTEREY COUNTY
SALINAS
7
14
STUDY AREA BOUNDARY
NORTH
0 1 2 3 4 5
SCALE IN MILES

FIGURE 2 EXISTING AND POTENTIAL EXPANSION OF MUNCIPAL SEWERED AREAS AND LOCATION OF WASTEWATER TREATMENT PLANTS

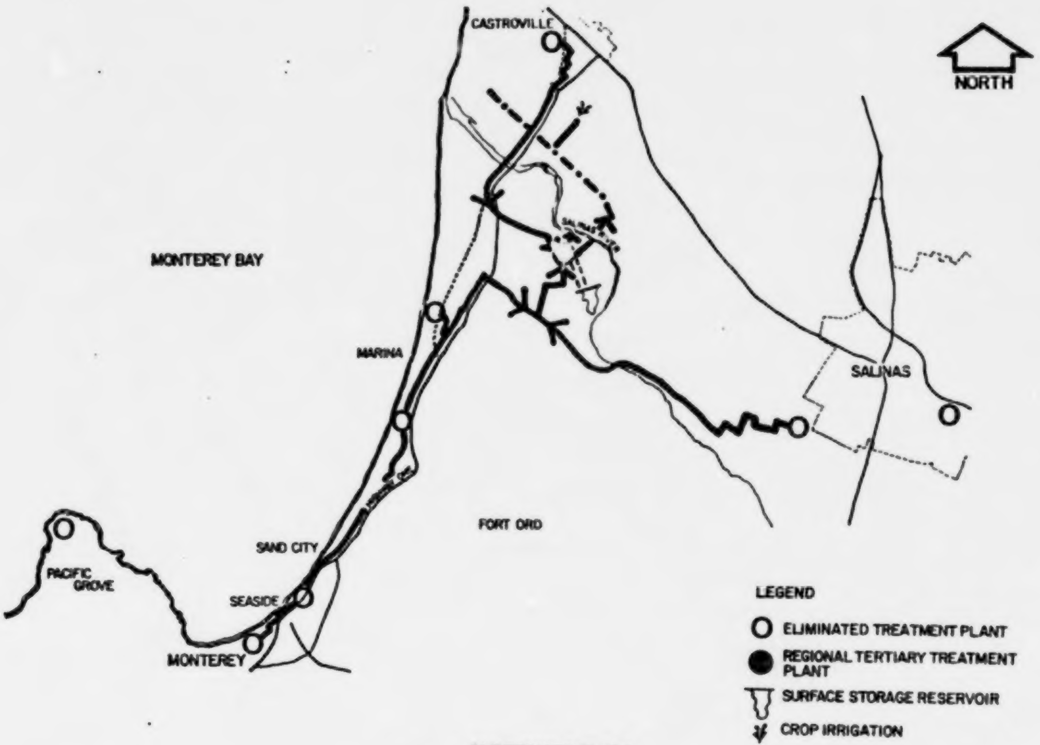
SOURCE: MODIFIED FROM ENGINEERING SCIENCE INC., 1976d.



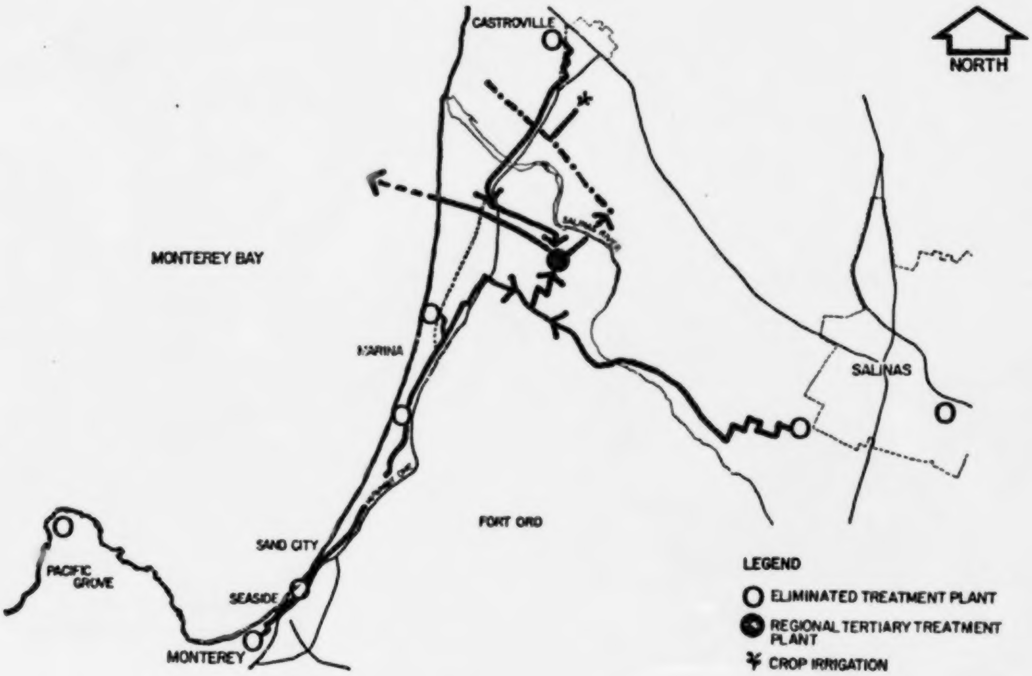
EXISTING WASTEWATER SYSTEMS



ALTERNATIVE I
OCEAN DISPOSAL
FIGURE 3

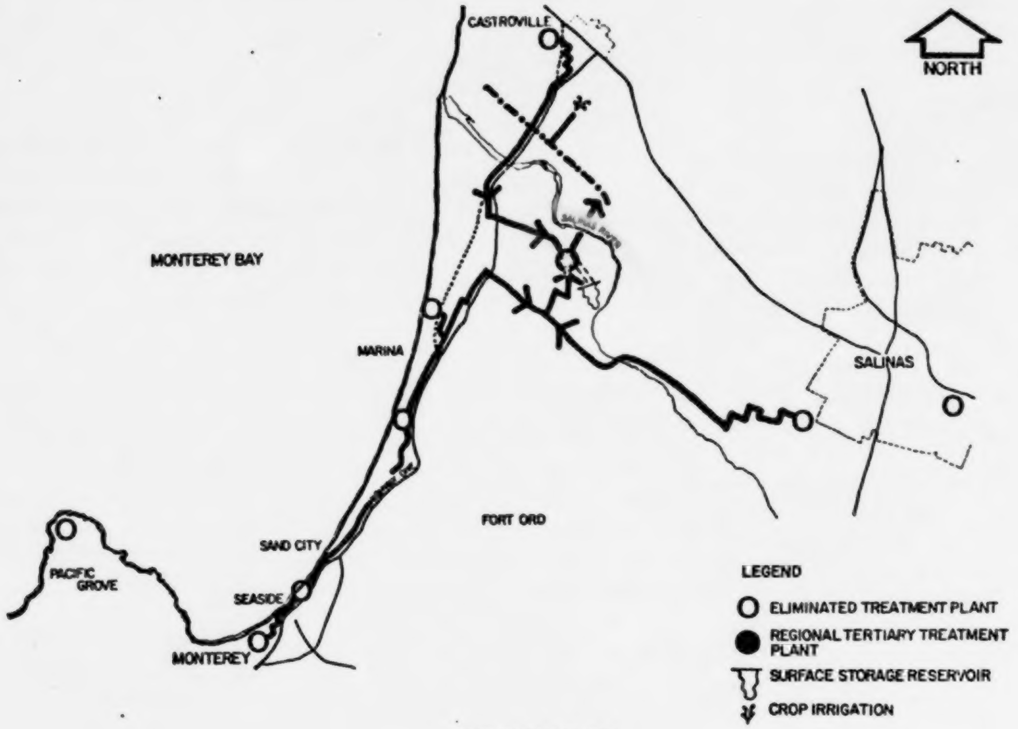


ALTERNATIVE 134
CROP IRRIGATION/RIVER DISPOSAL

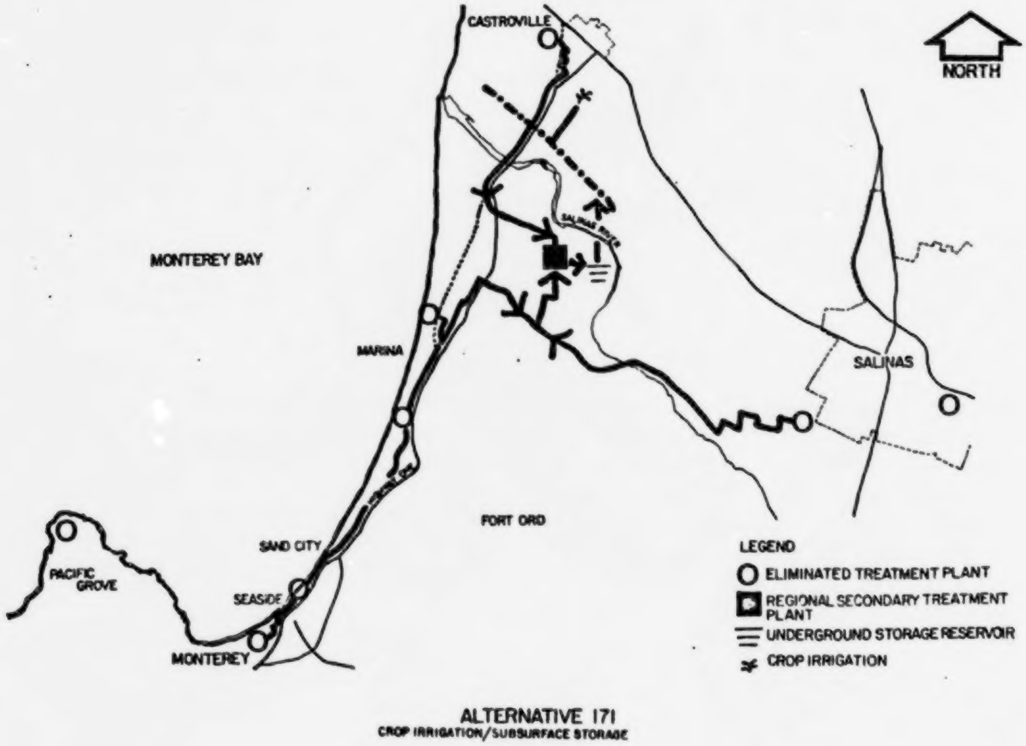


ALTERNATIVE 166
CROP IRRIGATION/OCEAN DISPOSAL

FIGURE 4



ALTERNATIVE 170
CROP IRRIGATION / SURFACE STORAGE



ALTERNATIVE 171
CROP IRRIGATION/SUBSURFACE STORAGE

FIGURE 5

and acted strictly in an advisory capacity. The five alternatives selected all include regional consolidation of wastewater flows from Castroville, Salinas and the Monterey Peninsula-South Bay coastline cities for treatment at a single plant near the mouth of the Salinas River. The treatment level and disposal/reuse plans of the five are as follows:

Alternative 1 - *Secondary treatment* (level 1A treatment, Table K-1) with year-round discharge through an *outfall* to central Monterey Bay.

Alternative 134 - *Tertiary treatment* (level IV treatment, Table K-1) and conveyance to the Castroville area for irrigation reuse from approximately April to October and discharge to the lower Salinas River or lagoon (level III or V) for the remainder of the year.

Alternative 166 - Tertiary treatment (level IV) and conveyance to the Castroville area for irrigation reuse from approximately April to October and discharge of secondary effluent through an outfall to central Monterey Bay (level 1A) for the remainder of the year. (This is Engineering Science, Inc.'s recommended plan.)

Alternative 170 - Tertiary treatment (level IV) and conveyance to the Castroville area for irrigation reuse from approximately April to October and storage in a 900-acre reservoir for eventual irrigation reuse the remainder of the year.

Alternative 171 - Secondary treatment with *filtration* (level II) and year-round discharge to 185 acres of *percolation* ponds for additional treatment and subsurface storage; repumping and conveyance to the Castroville area for irrigation reuse from approximately April to October.

Impacts

Construction

Many of the construction impacts are common to all five regional alternatives, as they would result from laying the common wastewater *interceptors* and building the regional treatment plant. These impacts include *short-term* traffic, residential and commercial disruption; creation of nuisance noise and dust; and elimination of grassland and grazing areas north of Marina. The major construction impacts specific to individual alternatives are as follows:

Alternative 1 - Excavation or covering of at least 6,400 linear feet of sandy bottom habitat in Monterey Bay for emplacement of an outfall; short-term *turbidity* of bay waters and possible beach erosion.

Alternative 134 - Excavation of a 120-acre storage pond in grassland habitat north of Marina (to be used for emergency storage, irrigation delivery flow regulation and storage of *effluent* during start-up of nitrification units in the treatment plant); possible loss of *riparian* habitat and short-term *sedimentation* of the Salinas River from irrigation delivery pipeline construction across the river.

Alternative 166 - Outfall emplacement impacts similar to those described for Alternative 1 and irrigation delivery pipeline impacts similar to those described for Alternative 134; removal of a small acreage of grassland habitat for a flow regulation and emergency storage reservoir (4 or 5 acres).

Alternative 170 - Irrigation delivery pipeline impacts similar to those of Alternative 134 and loss of up to 900 acres of grassland north of Marina for creation of a surface storage reservoir.

Alternative 171 - Irrigation delivery pipeline impacts similar to those of Alternative 134 and loss of up to 185 acres of grassland north of Marina for construction of percolation-infiltration ponds.

Operation

Impacts from operation of the five systems can be divided into social, economic and physical environment elements. The social impacts of the five are quite similar. Each would supply wastewater service to the same area and same population, thereby influencing growth in a similar manner. All except Alternative 1 would satisfy the public's expressed desire to reuse the wastewater to ease the local water shortage situation. Alternatives 170 and 171 could supply virtually all of the wastewater produced in the service area (14,500 *acre-feet* per year in 1982) for reuse, while Alternatives 134 and 166 would produce considerably less (8,400 acre-feet per year) for reuse.

The differences in the economic impact of the alternatives would reflect the differences in construction and operation and maintenance costs (A summary of costs is presented below). The cost to each household or business served by the new system would fluctuate according to the differences in these costs. A detailed financing and revenue plan has been prepared for the alternative (#166) recommended in the Facilities Plan;

this initial revenue program indicates the wastewater systems would require about $4.50 per month in user charges for single-family dwellings (Bartle Wells Associates, 1976). The local participating agencies would levy an additional charge to operate and maintain the local collector systems. Costs for industrial and commercial establishments would fluctuate according to size and water use. User costs for the other project alternatives would vary with the relative difference in construction and operation costs expressed in the table below.

ESTIMATED COST OF ALTERNATIVES***
(millions of dollars)

	Construction Cost	Operation and Maintenance Cost*(1996)	Total Present Worth (1975 $)
Alternative 1	53.8	2.2	55.6
Alternative 134			
Option A**	69.4	2.9	68.0
Option B	77.1	3.4	73.4
Alternative 166	64.7	2.4	60.1
Alternative 170	82.0	2.7	71.2
Alternative 171	51.5	2.4	53.5

* Dollars per year.
** Option A includes use of treatment levels III and IV, Option B includes levels V and IV (see Appendix K).
*** Detailed cost breakdowns are presented in Table M-5.

The impacts to the natural or physical environment vary considerably from one alternative to the next, but each would solve the major water quality and public health problems associated with existing wastewater discharges. (The "no action" alternative would perpetuate the problems.) Alternative 1 would relocate all discharges to a single spot in central Monterey Bay where new public health problems are not likely to develop. The change in water quality at the point of discharge could stimulate a local change in species diversity and a gradual increase in the *heavy metals* content of adjacent bottom sediments. The long-term effects on biota are not completely known, however. Studies of outfalls in similar marine habitats indicate sedimentation and scouring immediately adjacent to a raised pipe can permanently remove *benthic* organisms in a narrow band along the pipe itself (Weaver, pers. comm.). Species composition and diversity in the immediate vicinity of the freshwater plume is also likely to change. *Demersal* species tolerant to the freshwater source are likely to increase in abundance while less tolerant species are likely to avoid the area (Southern California Coastal Water Research Project, 1973). The predischarge oceanographic survey required by the SWRCB is designed to identify and elaborate on potential changes in the marine environment in the vicinity of the proposed outfall.

The four *wastewater reclamation* alternatives would discharge effluent to various land or surface water areas, with varying potentials for creating new water problems. The two storage alternatives (170 and 171) would apply the most wastewater to croplands and therefore have the greatest risk of eventually degrading the surface *aquifer* (which is already of poor mineral quality and seldom used) in the lower Salinas Valley and increasing quality problems associated with agricultural runoff. They would, however, provide the opportunity to reuse a very substantial amount of water, thereby limiting or potentially improving groundwater overdraft and salt water intrusion problems. Alternatives 134 and 166 would apply less wastewater to croplands, but would require non-irrigation season discharges to surface waters. The Alternative 166 bay discharge would have effects similar to those of the Alternative 1 outfall mentioned above but would occur only in the winter months when water-contact recreation is minimal. The Alternative 134 lower Salinas River discharge could create public helath and water quality problems in both the river and the Elkhorn Slough *estuary* system if the treatment plant malfunctioned, but water quality might also improve in low flow periods because of the increase in freshwater flows through the lagoon. Despite these potential new water-related problems, the reuse aspect of the four reclamation options is a significant environmental benefit to the water-short study area.

All five of the proposed regional alternatives would have an adverse but mitigable effect on fish, wildlife and vegetation along the lower Salinas River (between the Salinas discharges and the lagoon) from removal of the Salinas discharges. Because each alternative, except no action, has the same effect, this should not play a role in selecting a best project. Alternative 134 could, however, benefit the fish and wildlife resource in the Salinas River lagoon by providing an additional freshwater source during the non-irrigation (November to March) season; this would be especially valuable when low flows extend well into October or November.

While no action and Alternative 1 would have the least direct impact on land use, the four reclamation alternatives could have a significant impact on agricultural use in the Castroville area. Long-term use of wastewater for irrigation could adversely affect the viability of soils and require costly changes in farming practices. Crop marketability could also be adversely affected. In contrast, the new water source could prolong the viability of farming in areas that are facing a rapid deterioration in the quality of existing groundwater supplies. The *nutrients* in wastewater could also have some value as a source of fertilizer. These potential impacts, which are not completely predictable with present information, are to be studied in detail through a pilot agricultural irrigation project prior to initiating full-scale irrigation reuse.

Secondary Effects

Each of the proposed regional alternatives would have essentially the same indirect or secondary impact on the study area. The effects or impacts are related primarily to the level and location of population growth the new wastewater facilities could support. Typical effects associated with growth include deterioration of air quality, conversion of agricultural land, increased pressure on public facilities and cultural resources, and loss of open space and wildlife habitat. Wastewater facilities normally do not independently stimulate growth; there are a variety of services and economic conditions that must exist before new development can occur in a given region. New facilities can, however, remove an existing impediment to growth and play a major role in determining the location of growth.

The regional wastewater facilities have been designed to sewer 289,300 of an estimated 1995 study area population of 338,300. Because grant funding for the treatment plant is available for only a 10-year increment, it will initially be sized for a 1990 sewered population of about 263,600. With a 1970 study area population of 190,606 (including Ft. Ord), the facilities have been designed assuming a 25-year study area population growth of 147,694, or a compounded growth rate of about 2.3 percent.

The effects this growth might have on the local environment depends primarily on the location and type of new development. An analysis of existing local plans indicates some infilling may occur in the Monterey Peninsula cities and in Salinas, but the major expansions are likely to occur north of Salinas, near Castroville and Marina, and along the Salinas-Monterey and Castroville-Prunedale transportation corridors. The land use changes would be the most obvious impact of the growth. Prime agricultural land being actively cultivated in the Salinas and Castroville areas would probably be lost to residential-commercial use, as would open space and grazing land along the two transportation corridors (Highway 68 and 156) and in the vicinity of Marina. Provision of the usual public services and facilities would also be required (i.e., schools, roads, police and fire protection), placing additional responsibilities and costs on local government.

An increase in local water demand is perhaps the most serious potential problem associated with growth in the planned service area. The severe water shortage on the Monterey Peninsula and the rapid overdrafting and deterioration of groundwater supplies in the Castroville-Salinas area would be further compounded if growth is allowed to occur in the absence of new sources of water and/or major water conservation efforts. Agricultural reuse of the new treatment system's wastewater, as proposed in several of the project alternatives, could mitigate in-part future increases in local water demand.

Increases in urban land also affect local water quality conditions by increasing *non-point sources* of pollution. Urban runoff is typically high in metallic compounds, biostimulants, oil and grease, and *biochemical oxygen demand* (BOD). Erosion associated with construction activity adds to siltation of surface waters. The increase in amount of *impermeable* ground surface (pavement, structures) adds to the volume of surface runoff and decreases groundwater recharge from precipitation.

The principal potential impacts of growth on vegetation and wildlife include removal of vegetation, loss of habitat and increased human activity in or near natural areas. Growth along the Monterey-Salinas corridor and the Prunedale-Castroville corridor would eliminate oak-grassland and possibly riparian wildlife habitat. Additional development in the Moss Landing-Castroville area would increase human pressures on the valuable Elkhorn Slough estuarine complex, which is inhabited by several rare and endangered bird species. Sound planning for specific development projects can avoid the more significant losses of habitat, but the general increase in human activity is unavoidable.

If development occurs at the rate projected by local planning agencies (and as assumed for project planning), oxidant levels in Monterey County can be expected to improve slightly. Federal health-related standards for oxidant level will probably continue to be exceeded at least a few times each year unless highly favorable weather conditions persist during the 1985-1990 period. Nitrogen dioxide levels will increase substantially and can probably be expected to exceed the California 1-hour standard on an occasional basis during the 1990-1995 period.

Mitigation Measures

A wide variety of *mitigation* measures have been suggested to reduce the severity of or eliminate the potential direct and indirect adverse impacts of the proposed wastewater project. Controls to reduce the impact of construction activity (to be implemented by the wastewater management agency and its construction contractors) include: limiting construction activity and equipment to the smallest area possible; locating corporation yards and materials stockpiles in areas that avoid degrading local aesthetics; providing alternate or secondary traffic routes around construction areas so as to minimize traffic disruption; and revegetating all disturbed surfaces to minimize erosion and aesthetic degradation.

In order to mitigate the reduction in dry-weather stream flow in the lower Salinas River (caused by removing the existing Salinas wastewater discharges), several alternative sources of surface flow have been suggested, including pumping of groundwater, releasing additional water from upstream reservoirs, and use of treated wastewater from the new regional plant. The feasibility of these options remains to be further investigated; implementation would be by the local wastewater management agency.

Numerous recommendations have been made to control the effects of the irrigation reuse of the wastewater. Implementation of an irrigation demonstration project is the most important factor, as this would accurately identify problems. Changes in plowing and irrigation practices have also been suggested to maintain agricultural productivity and minimize groundwater impacts in the face of a change in water supply. The farmers themselves would be responsible for these mitigations.

Potential impacts on surface and groundwater quality are best controlled by providing the best possible quality of wastewater. This should be accomplished by the wastewater management agency through proper source control (i.e., requiring pretreatment or elimination of waste flows with high pollutant levels at the source of the flow, prior to discharge to the wastewater collection system) and use of the most advanced treatment processes that are economically feasible.

A summary of potential mitigation measures and the entities most likely to implement them follows the Recommendation section.

Recommendation

The soundest wastewater treatment and disposal system for north Monterey County could actually contain elements of several alternatives. First, regional interceptors and a central treatment plant are an acceptable framework for the system. Reuse through irrigation should also be a part of the system. An irrigation demonstration project has already been initiated to resolve agricultural and public health questions related to reuse; testing is scheduled to commence in the 1978 growing season. The storage alternatives (170 and 171), when considered strictly as diagrammed in Figure 5 (no secondary disposal mode), are not conducive to staging. The treatment and storage facilities must be constructed simultaneously. They also require large land areas. Therefore, storage should be considered only after reuse is proven feasible and it is felt the costs are justified. Storage could then be added to either Alternative 134 or 166.

It appears that a choice must be made as to which disposal method should be used while the agricultural demonstration project is in progress. The choice is clearly between ocean discharge (Alternative 166) and lower Salinas River discharge (Alternative 134). The ocean outfall would utilize a generally acceptable, reliable disposal method. The river disposal could be beneficial to fish and wildlife resources in the Salinas River lagoon, but further analysis of river and lagoon water quality conditions is needed before the full impact of this option is known. Deep water ocean disposal is clearly best able to meet the PL 92-500 goal of assuring "fishable-swimmable" water quality conditions in the area's surface waters by 1983. However, ocean disposal alone does not offer the best opportunity to reuse a valuable water resource and reduce salt water intrusion/overdrafting in the Salinas Valley. Therefore, a decision must be reached as to whether the benefit to the lagoon wildlife is significant enough to delay a choice between ocean and river disposal and initiate a complete study of lagoon water quality in light of the anticipated higher construction and operation costs of the river disposal alternative.

SUMMARY - IMPACT MITIGATION MEASURES

Mitigation	Possible Implementing Entity(ies)*
CONSTRUCTION IMPACTS	
o Source control of noise, air emissions, dust.	Construction contractor
o Avoid, minimize removal of vegetation; keep disturbed area as small as possible, reseed.	Construction contractor
o Reroute, control flow of traffic.	Construction contractor
o Avoid construction through critical wildlife habitat, scenic areas, agricultural land.	MPWPCA
OPERATION IMPACTS	
Soils-Agriculture	
o Utilize highest level of wastewater treatment possible, implement source controls.	MPWPCA
o Practice deep soil tillage	Local farmers
o Increase water applications to *leach* salts.	Local farmers
o Blend water sources.	Local farmers
o Irrigate only at night	MCFCWCD, CID, local farmers
Water Quality	
o Increase irrigation efficiency to reduce agricultural runoff.	Local farmers
o Pretreat agricultural runoff before discharge	Local farmers, RWQCB
o Utilize highest level of wastewater treatment possible, implement source controls.	MPWPCA
o Install tile underdrains in wastewater irrigation areas.	Local farmers
o Dewater *sludge* prior to landfilling.	MPWPCA
Public Health	
o Avoid wastewater irrigation in the vicinity of domestic wells.	MCEHD, local farmers
o Line all wastewater storage ponds with impermeable materials.	MPWPCA
o Install tile underdrains in wastewater irrigation areas.	Local farmers
o Follow wastewater irrigation guidelines of State Department of Health, Title 22 of California Administrative Code.	MCEHD, CDH
o Utilize highest level of wastewater treatment and *disinfection* possible.	MPWPCA
o Implement vector control program at reservoirs through local mosquito abatement districts.	MPWPCA, NSVMAD
Resources	
o Utilize those treatment processes with lowest chemical and energy requirements.	MPWPCA
o Select pipeline routes, treatment plant location with least pumping requirements.	MPWPCA
o Utilize digestor, landfill-generated methane for treatment plant energy source.	MPWPCA
Wildlife, Vegetation	
o Maintain summer flow in the lower Salinas River by:	
1. Pumping groundwater near Salinas.	MPWPCA, City of Salinas
2. Pumping regional plant effluent upstream for discharge.	MPWPCA
3. Retain Salinas plant wastewater discharge to river.	City of Salinas, MPWPCA

Mitigation	Possible Implementing Entity(ies)*
4. Additional upstream water releases.	MPWPCA, MCFCWCD
o Use of treated wastewater for habitat enhancement on Department of Fish and Game wildlife area.	DFG, CDH, MCEHD
o Utilize highest level of wastewater treatment possible, implement source controls.	MPWPCA
Economics	
o Implement least costly treatment and disposal alternative possible.	MPWPCA
o Limit treatment facilities sizing to that level considered grant fundable by EPC and SWRCB.	MPWPCA
o Eliminate as much infiltration/inflow as possible.	MPWPCA, local public works departments
o Initiate water conservation and wastewater flow reduction programs.	MPWPCA, SWRCB, RWQCB, local government, public at large
GROWTH-RELATED IMPACTS	
General - Land, Water, Wildlife, Vegetation Resources	
o Size wastewater treatment facilities for existing service area population only.	MPWPCA
o Encourage high density development in newly urbanized areas.	Local planning agencies, city councils, MCBS
o Encourage infill rather than peripheral development or sprawl.	Local planning agencies, city councils, MCBS
o Utilize Williamson Act land protection.	Local planning agencies, city councils, MCBS, local landowners
o Implement a wastewater reclamation alternative to augment local water supplies.	MPWPCA
o Modify general plans and zoning ordinances to protect recognized valuable resources, i.e., rare and endangered plants, wildlife, unique vegetation.	Local planning agencies, city councils, MCBS
Air Quality	
o Adopt more stringent vehicle emission standards.	EPA, ARB
o Adopt more stringent point source emission standards.	MBUAPCD
o Control development of new industrial sources of pollution through general plan and zoning amendments, changes in conditional use permit procedures.	Local planning agencies, city councils, MCBS
o Reduce overall vehicle travel by:	
1. Modifying general plans and zoning ordinances to encourage infill and reduce urban sprawl.	Local planning agencies, city councils, MCBS
2. Design new residential areas to facilitate bus service.	Local planning agencies, MPT
3. Improve local transit service, encourage carpooling.	Local government, MPT
4. Encourage new development planning that facilitates non-motorized travel.	Local planning agencies
o Invoke temporary treatment plant flow limitations until alternate mitigations are devised.	EPA, SWRCB

* FOOTNOTES FOR SUMMARY - IMPACT MITIGATION MEASURES

ARB	California Air Resources Board
CDH	California Department of Health
CID	Castroville Irrigation District
DFG	California Department of Fish and Game
EPA	U. S. Environmental Protection Agency
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MCBS	Monterey County Board of Supervisors
MCEHD	Monterey County Environmental Health Department
MCFCWCD	Monterey County Flood Control and Water Conservation District
MPT	Monterey Peninsula Transit
MPWPCA	Monterey Peninsula Water Pollution Control Agency
NSVMAD	Northern Salinas Valley Mosquito Abatement District
RWQCB	Central Coastal Regional Water Quality Control Board
SWRCB	California State Water Resources Control Board

INTRODUCTION

Purpose and Objectives of the Environmental Impact Statement

The National Environmental Policy Act of 1969 (NEPA) requires all federal agencies which propose actions that would significantly affect the quality of the human environment to prepare an Environmental Impact Statement (EIS) on these actions. The EIS is intended to be a "full disclosure" of impacts which would result from a project or action, and must follow specific guidelines established by the Council on Environmental Quality (CEQ). In the selection of a wastewater facilities plan, it is the intent of NEPA that alternatives be evaluated and a plan selected on the basis of all environmental considerations, not just monetary costs.

The California Environmental Quality Act of 1970 (CEQA), which was modeled after NEPA, also requires preparation of an Environmental Impact Report (EIR) when state or local agency activities may have a significant impact on the environment. Because the North Monterey County regional wastewater project can be 75 percent funded by the Environmental Protection Agency (EPA) and 12-1/2 percent funded by the State Water Resources Control Board (SWRCB) as a part of the Construction Grants Program authorized by the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), it requires both CEQA and NEPA action. In order to eliminate repetition in the report preparation process, EPA and MPWPCA have jointly participated in preparation of this document, which satisfies both the EIS and EIR requirements.

The EIS objective is to identify significant environmental impacts and resolve issues of public controversy associated with the proposed North Monterey County Facilities Plan. This EIS, following the guidelines of the NEPA, objectively evaluates combinations of project alternatives and determines which appear to be environmentally the most acceptable. All relevant monetary, social and environmental effects are included in the analysis.

Data for this EIS have been compiled from various existing studies of the Monterey-Salinas area, numerous personal conversations with involved individuals and additional studies conducted by the EIS consultants. A complete listing of references is in the Bibliography.

The EIS process encourages public input into the decision-making process. This draft EIS is being widely circulated for public comment. Approximately thirty days after its release, a public hearing will be held to receive oral comments. Written comments will be accepted for 45 days after its release. Following the hearing and the 45-day public comment period, a final EIS will be prepared, addressing all pertinent questions raised.

Area Affected

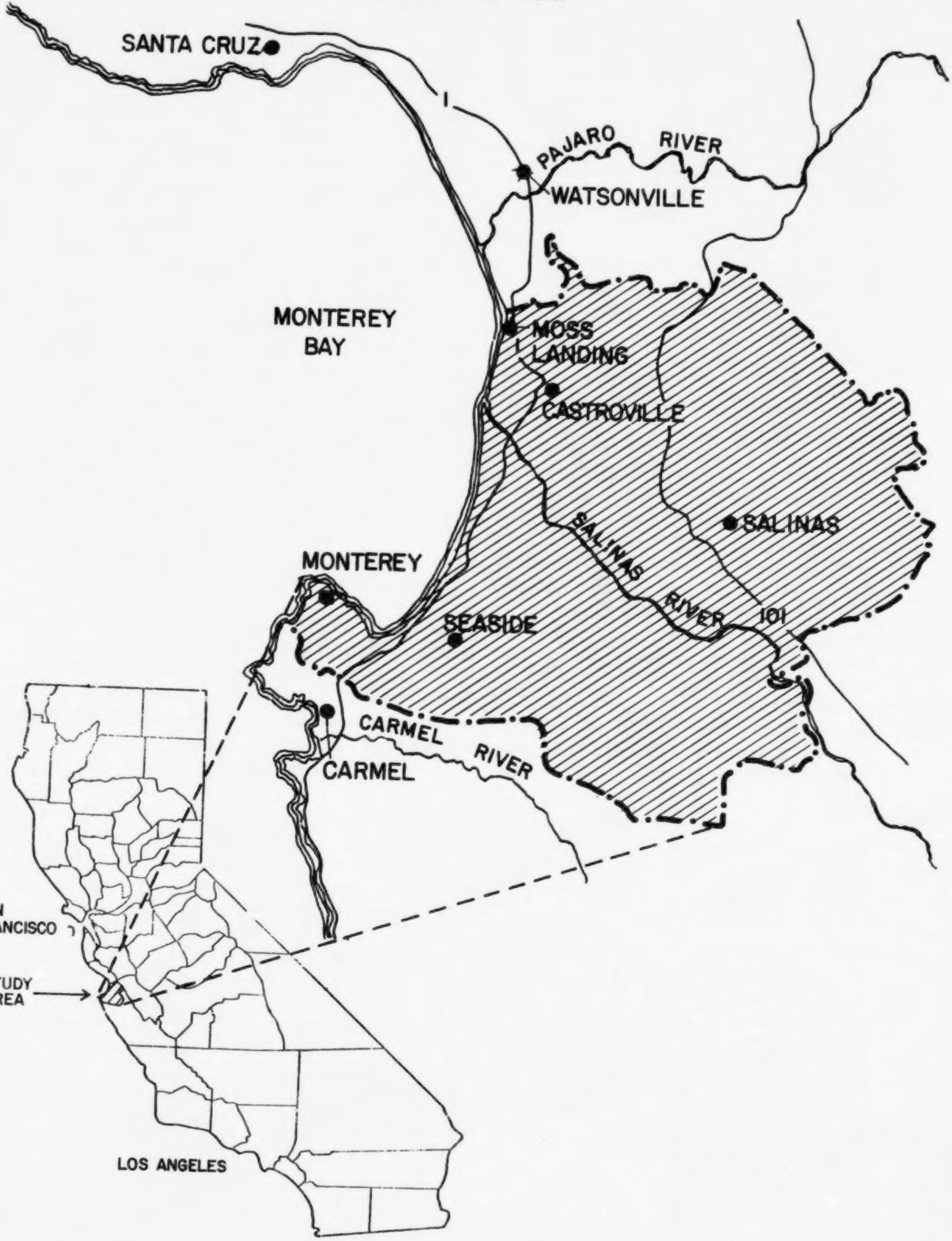
The project under consideration in this EIS is located in northern Monterey County, California, approximately 75 miles south of San Francisco (see Figure 6). The major communities involved are the cities of the Monterey Peninsula and Salinas. A detailed description of the region is presented in the Environmental Setting section.

Background and History

The existing wastewater treatment and disposal systems in the Monterey-Salinas area are contributing to undesirable water quality conditions in several of the region's surface waters, including the Salinas River, Tembladero and Elkhorn Sloughs, and Monterey Bay. The adverse aesthetic and public health conditions being created in these waters are due in part to both the quality of wastewater effluent being discharged and inadequate dilution and dispersion provided by the receiving waters. These conditions and increasing state and federal restrictions on disposal of wastewater have prompted wastewater management planning efforts in northern Monterey County.

Serious groundwater overdrafting and a water supply shortage also exist in the Monterey Peninsula and Salinas Valley area. Heavy domestic, industrial and agricultural groundwater pumping in the lower Salinas Valley has caused sea water to intrude into the underground aquifers that are tapped for local water supply. Water consumption in the Monterey-Seaside area has outstripped developed surface and groundwater supplies, resulting in a California Public Utilities Commission-imposed moratorium on water connections, resulting in a building ban. The need to improve wastewater treatment and remedy the water shortage situation have both influenced the wastewater management planning described in the following paragraphs.

FIGURE 6
LOCATION MAP



The Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) require that all *municipal wastewater* treatment facilities produce an effluent meeting secondary treatment standards (defined in "EPA Secondary Treatment and Treatment Information", Federal Register, Vol. 40, No. 159, August 15, 1975) by July 1, 1977 and that there be no discharge of pollutants to the nation's waters by July 1, 1985. Section 303(e) of P.L. 92-500 provides for the preparation of basin-wide plans to determine the best practical method of accomplishing the law's objectives. The California State Water Resources Control Board (SWRCB) and the Central Coastal Regional Water Quality Control Board (RWQCB) have cooperated in preparing a basin plan for the central coastal basin, which includes most of Santa Cruz, San Benito, Monterey, San Luis Obispo and Santa Barbara Counties. The plan establishes water quality objectives and *beneficial uses* for the waters of the basin and makes recommendations for the wastewater treatment and disposal facilities necessary to meet the objectives and protect the beneficial uses. The basin plan recommendation for northern Monterey County calls for consolidation of wastewater flows from the Monterey Peninsula and Bay communities, Salinas, and Castroville with treatment at a single regional plant near the mouth of the Salinas River. The wastewater would be treated to a secondary level and discharged to Monterey Bay initially. Reclamation and reuse for crop irrigation would be investigated and implemented where demand is established. Regionalization of treatment and disposal is recommended to eliminate current discharges to southern Monterey Bay and the lower Salinas River, to encourage the large-scale reuse of wastewater and to improve wastewater management in the area. EPA, in their letter of approval of the Basin Plan, stipulated that the plan's recommendations for municipal facilities will be modified on a case-by-case basis of subsequent, more detailed investigations, including preparation of environmental impact reports or statements, justify the need for reconsideration.

The Monterey Peninsula Water Pollution Control Agency (MPWPCA) was formed in 1971 to develop a new wastewater management system for the cities on the Monterey Peninsula. Since publication of the area's basin plan (which recommended a consolidated wastewater management approach for the Monterey County communities bordering Monterey Bay), MPWPCA's study scope has expanded to include the Salinas and Castroville areas. The MPWPCA joint powers agreement now includes the City of Monterey, City of Pacific Grove, City of Salinas, County of Monterey, Marina County Water District and the Seaside County Sanitation District. The U. S. Army at Ft. Ord is an ex-officio member. Using funds established by P.L. 92-500 and administered by the SWRCB through the Clean Water Grant Program, MPWPCA is preparing a wastewater facilities plan for most of northern Monterey County.

The planning was initiated in March of 1975 when MPWPCA received a facilities planning grant from the SWRCB. Subsequently, Engineering Science, Inc. was retained to prepare the facilities plan. A list of 173 possible alternative plans were developed by the engineers. Guidelines and objectives included in the basin plan and discharge requirements established by the Central Coastal RWQCB were used to develop these alternatives. In June of 1975, a contract was let by MPWPCA to Jones & Stokes Associates, Gruen Gruen + Associates, and Don Owen & Associates to prepare an EIS on the facilities plan. The recently established "piggy-back" process, whereby the facilities plan and the EIS are prepared simultaneously rather than in sequence, was adopted to shorten the planning time frame. Since that time, the 173 alternatives have been subjected to engineering, economic and environmental analyses by the engineering and environmental consultants and a technical advisory committee (TAC) composed of federal, state and local planning and regulatory agencies. Public workshops were held in Monterey on September 10, 1975 and February 9, 1976 and in Salinas on September 11, 1975 and February 10, 1976 to receive public reactions to the proposed alternatives. As a result of this planning process, five alternatives were selected for detailed analysis. The Facilities Plan for North Monterey County and this EIS present that detailed analysis. The plan recommended for implementation must meet the objectives of P.L. 92-500 and the Central Coastal basin plan in a cost-effective manner. The Environmental Protection Agency must also insure compliance with all national environmental quality legislation prior to issuing grant funds for detailed design of a recommended plan.

In preparing the Central Coastal Basin Plan, the SWRCB evaluated the possibility of including the Carmel area in the Monterey Bay regional system. The cost analysis indicated pumping to Monterey was the most costly of four proposed alternatives, therefore treatment and disposal through the Carmel Sanitary District facilities was recommended. The Pebble Beach-Carmel-Carmel Valley area was placed in a sub-basin of its own, separated from the Monterey Bay Coastal area. Facilities planning in the two areas has proceeded separately since that time. The North Monterey County Facilities Plan has not included capacity for the Carmel area in its facilities design. Interceptor, treatment plant and disposal facility sizes would probably have to be increased to accommodate Carmel flows.

Although Moss Landing is within the North Monterey County Facilities Plan study area, the severity of its existing wastewater treatment problems has prompted a separate facilities planning effort. Currently, septic tanks are providing for most of the treatment in Moss Landing, but many are failing due to adverse soil and groundwater conditions. A draft facilities plan and environmental impact report were prepared for Moss Landing and submitted to MPWPCA and the State Clearinghouse for review (Jones & Stokes Associates, Inc., 1976b). A public hearing on the draft EIR was held in Moss Landing on August 30, 1976 and a final EIR was subsequently prepared. Economic, engineering and environmental analyses of alternative wastewater treatment and disposal systems for the Moss Landing area are included in these documents. Copies of the EIR are on file in area libraries and at the MPWPCA offices.

Existing Facilities

Sewage treatment in the facilities plan study area is currently supplied by nine public treatment facilities (including one industrial facility at Salinas), several private community-type systems and numerous individual septic tanks. The location, discharge point, present service area, design capacity, and current average flows of the public treatment systems are shown in Figure 2. The Salinas industrial ponds are shown in the figure but are not included in the current planning effort, as they have sufficient capacity and treatment to meet projected treatment requirements and demands. Each of the eight domestic wastewater systems must undergo some modification in order to comply with either PL 92-500 or the basin Water Quality Control Plan.

The City of Salinas operates two domestic wastewater facilities, the Salinas main plant and the smaller Salinas-Alisal plant. Both plants provide a secondary level of treatment and discharge to the lower Salinas River just west of the City of Salinas. In order to conform to the SWRCB's basin plan, these plants must remove their discharges from the river or upgrade treatment to a tertiary level. The basin plan recommends abandonment of the Salinas plant and transport of Salinas' wastes to a regional system.

The Castroville County Sanitation District plant produces a secondary level of effluent and discharges to Tembladero Slough. However, in order to meet the 1977 secondary requirements of PL 92-500, it must improve its treatment. This improvement may be accomplished as part of a proposal to sewer the community of Moss Landing and transport its wastes to the Castroville plant for treatment. The SWRCB basin plan recommends Castroville remove its discharge to Tembladero Slough and initiate land disposal until the Moss Landing and Prunedale areas are sewered and connected to Castroville. They would then be tied as a unit into a regional system.

The City of Pacific Grove is currently discharging primary effluent to the ocean at Point Pinos. As part of stage 1 of a regional consolidation project, an interceptor is already designed to transport Pacific Grove's wastewater to the Monterey plant for treatment and disposal. This is planned as an interim step, with the combined Pacific Grove-Monterey flow eventually going to a regional system.

The City of Monterey plant is being upgraded to discharge a secondary-level effluent to the ocean. This discharge and those of Ft. Ord, Seaside County Sanitation District and Marina County Water District lie within a discharge prohibition zone established by the SWRCB in the basin plan. The prohibition seeks to eliminate all domestic waste discharges to a sluggish circulation area in southern Monterey Bay, landward of a line drawn from Point Pinos to the mouth of the Salinas River (see Figure 24). The basin plan calls for removal of these discharges by July 1, 1977 and consolidation of the flows into a regional system.

The Seaside County Sanitation District is currently discharging *primary treated* effluent to the near-shore waters of Monterey Bay. As mentioned above, the SWRCB basin plan calls for elimination of this discharge. The treatment level does not meet PL 92-500 1977 requirements.

The Ft. Ord main treatment facility currently discharges secondary effluent to the ocean across Indian Head Beach. Designs have been prepared to eliminate this discharge in 1977 and initiate a land disposal and irrigation reuse project on Army property near Fritzche Airfield. Ft. Ord is scheduled to tie into the proposed regional wastewater treatment system once it is constructed.

The Marina County Water District also operates a secondary level wastewater treatment system with disposal to Monterey Bay. In order to comply with the SWRCB south bay discharge prohibition, Marina must eliminate or extend its outfall. The basin plan recommends removal of the ocean discharge and consolidation with a regional system.

The current facilities planning being conducted by MPWPCA is designed to meet the requirements of PL 92-500 and comply with the discharge prohibitions and recommendations in the SWRCB basin plan. The planning also seeks to respond to environmental concerns expressed by residents of the study area. The current water supply shortage on the Monterey Peninsula and the rapid deterioration of the quality of groundwater in the lower Salinas Valley have stimulated support for reclamation and reuse of domestic wastewater as a water conservation measure.

Report Organization

The report is organized into a number of separate chapters, each with a different purpose. Preceding this Introduction, a Report Summary lists the major elements of the proposed wastewater project and their probable impact upon the study area environment. This provides a broad overview of the contents of the full EIS. The Environmental Setting describes the regional and site specific conditions currently existing within the project's main sphere of influence. Legal, regulatory and institutional constraints to development and implementation of the facilities plan are presented so that evolution and selection of the recommended plan can be better understood. The next section describes the development of project alternatives and the nature of those five plans being given detailed consideration in the facilities plan and this EIS. Finally, a number of separate chapters list the probable environmental impacts of each alternative plan and measures that can be taken to reduce or eliminate the impacts. A summary analysis of these impacts provides an overview of the detailed individual impact descriptions. The Glossary at the end of the report defines a number of terms that should be familiar to reviewing-agency technical staff but may be unfamiliar to the layman. These words are italicized where they first appear in the text.

Much of the technical data analyzed in preparing the environmental impact statement has been removed from the body of the text and included in appendices. This is done to improve the general readability of the report, yet still supply the technical backup for conclusions reached in the EIS. Figures and tables included in the appendices are given the appendix letter designation followed by a number (i.e., Table A-1 is in Appendix A, Figure B-2 is in Appendix B, etc.).

Public Input

Public participation in preparing this draft environmental impact statement started in the earliest stages of project planning. The Monterey Peninsula Water Pollution Control Agency Facilities Plan Technical Advisory Committee (TAC) assembled monthly throughout the last year and a half to consider environmental, economic and envineering aspects of the proposed plan. This TAC is composed of representatives from federal, state, regional and local public agencies that are in some way affected by wastewater collection, treatment and disposal ope-ations. The TAC's role in developing project alternatives is described in the Alternative Projects section of this report.

Questions and concerns of the public at large were solicited at four widely publicized public workshops held in Monterey and Salinas (September 10, 1975 and February 9, 1976 in Monterey and September 11, 1975 and February 10, 1976 in Salinas). The proposed project alternatives were explained and their potential impacts were listed prior to inviting questions and comments from the attendees. Strong public support was given to reclamation and reuse of wastewater at both workshops. Concerns were expressed about the location and type of reuse, however. It was mentioned that the location and type of reuse, plant may preclude reuse in the water-short Monterey Peninsula area. There was also concern over the potential adverse effects of reusing the water for irrigation of unprocessed food crops. Other opinions expressed at the workshops included support for use of land application as a wastewater treatment process, and a desire to have the inclusion of Carmel into the regional system considered in the planning process. Numerous other personal interviews and conversations have been held with government personnel and local residents in collecting and analyzing material for this report.

Public circulation of this draft EIS represents an additional effort to solicit public input into the facilities planning process. Public comment on the contents of this document and the direction of the plan itself may be made in the form of written communications or oral testimony at the EIS public hearing. All pertinent questions raised by the public over the draft EIS will be responded to in the final EIS.

ENVIRONMENTAL SETTING

Introduction

The physical, biological, and socio-cultural aspects of the project study area make up its Environmental Setting. The qualities of the environmental setting must be understood to determine what is necessary to solve environmental problems and to determine the impacts of building a regional wastewater treatment and disposal system in northern Monterey County.

The existing environment is described first regionally and then at the project site, where different project facilities could have varying impacts.

Existing Physical Environment

Location

The project study area is in northern Monterey County, California on the coast, about 75 miles southeast of San Francisco (see Figure 6). The area includes the incorporated Cities of Monterey, Salinas, Pacific Grove, Seaside, Sand City, Marina, and Del Rey Oaks, the unincorporated communities of Moss Landing and Castroville and Ft. Ord Military Reservation (see Figure 2).

Elkhorn Slough, Strawberry Canyon, and Echo Valley are on the northern border. The Monterey-San Benito County line, Quail and Jacques Hanlon Creeks, several sections of road, and a stretch of the Salinas River form the eastern boundary. The southern border follows various land grant boundaries just north of the Carmel River, and parallels the Pacific Grove-Carmel Highway across Monterey Peninsula. The Pacific Ocean marks the project's western edge. Some of these external boundaries are also boundaries of Association of Monterey Bay Area Governments (AMBAG) planning areas.

The 332 square miles of the study area are shown on U.S. Geological Survey topographic maps of Chualar, Hollister, Marina, Monterey, Mt. Harlan, Moss Landing, Prunedale, Rana Creek, San Juan Bautista, Salinas, Seaside, and Spreckels (7-1/2' series).

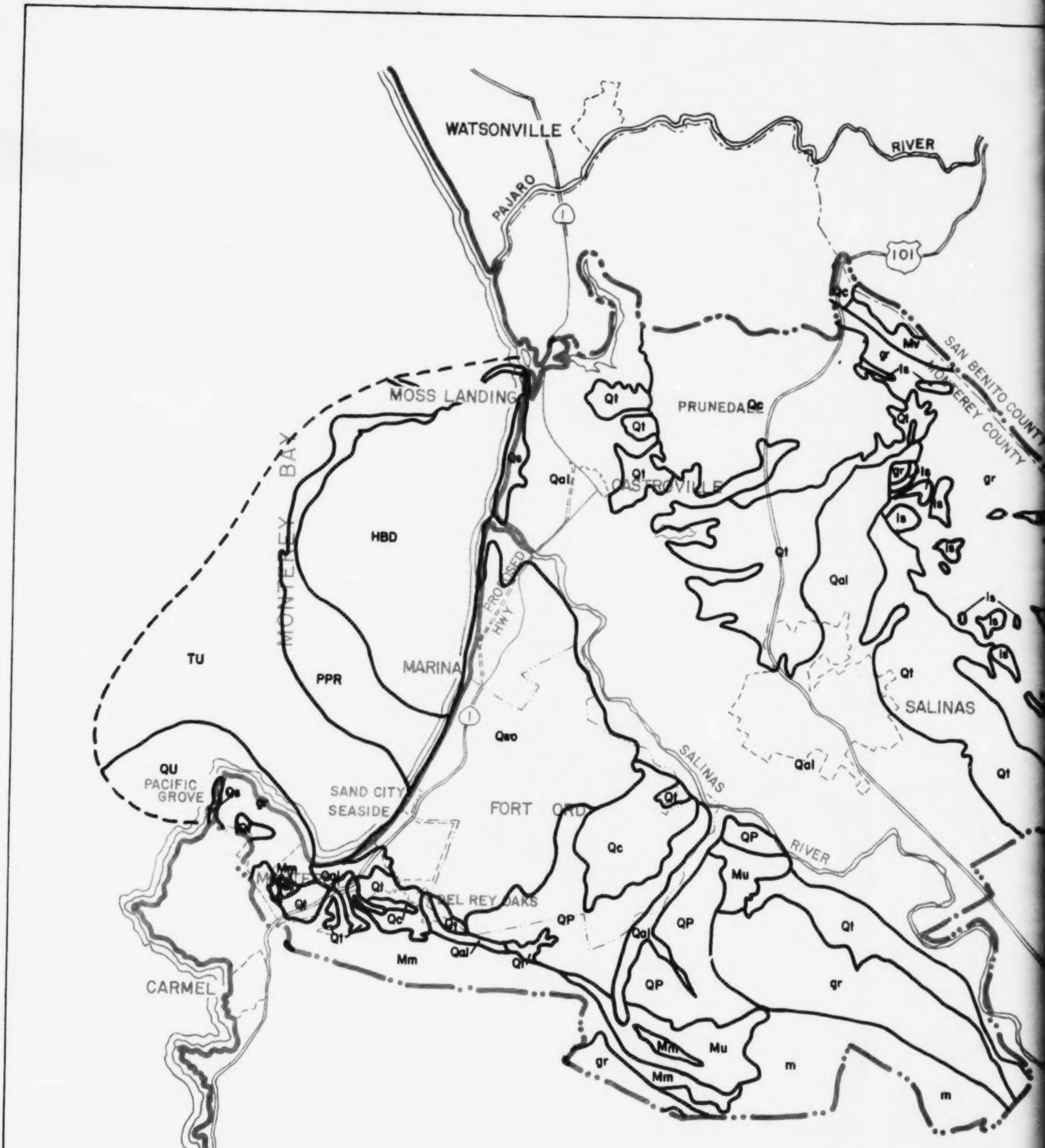
Land Resources

Topography. The topography of the study area is dominated by the Salinas River Valley and the Sierra de Salinas and Gabilan Mountain Ranges. Elevations range from sea level along the Pacific Coast to 3,500-foot Mt. Toro in the Sierra de Salinas and 3,100-foot Fremont Peak in the Gabilan Range.

The Salinas Valley ranges in elevation from sea level at the coast to about 30 feet above sea level 20 miles inland at the study area's eastern boundary. Gabilan Range elevations vary from 3,100 feet on the north edge of the study area to 2,500 feet in the south. The Sierra de Salinas Mountains reach 3,500 feet at the southeastern tip of the study area (see Figure 1).

Geology. The Gabilan and Sierra de Salinas Ranges are part of the northwest to southeast trending central California coastal mountains. Within the study area, each is composed chiefly of Mesozoic *granitic* rock with small areas of Pre-Cretaceous *metamorphic* material (see Figure 7). The granitic rock includes granite, adamellite, grandodiorite, tonalite, and diorite. The metamorphic rock is limestone and dolomite. Plio-Pleistocene and Pleistocene non-marine terrace deposits border the northern end of the Gabilans near Prunedale and the northern end of the Sierra de Salinas along El Toro Creek. The hills that stretch from the main block of the Sierra de Salinas near El Toro Creek to the coast at Carmel are *marine sediments* of Middle Miocene age (Jennings and Strand, 1959). These hills are the northwestern tip of the Santa Lucia Range. The granitic and marine sedimentary rocks form the basement complex of both ranges, while the non-marine sedimentary rocks are formed of material eroded from and deposited on the basement complex.

The Salinas Valley lies between the two mountain ranges and is one of the longest and broadest of the many valleys created by complex folding and faulting throughout California's Central Coast Range *geomorphic* province. The northern and southeastern borders of the Salinas Valley are covered by Quaternary nonmarine terrace deposits originally washed from the bordering mountains. These sedimentary rocks are replaced by older terrace deposits and younger dune sands along the western valley fringe from Spreckels to the coast. The valley trough and the *floodplains* of Gabilan Creek, Toro Creek, and Elkhorn Slough are composed of *Recent* alluvium deposited by existing streams.


WATSONVILLE
PAJARO
RIVER
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101
SAN BENITO COUNTY
MONTEREY COUNTY
MOSS LANDING
PRUNEDALE
Qc
Qt
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Qs
Qal
CASTROVILLE
MONTEREY BAY
HBD
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PPR
MARINA
PROPOSED HWY
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SAND CITY
SEASIDE
FORT ORD
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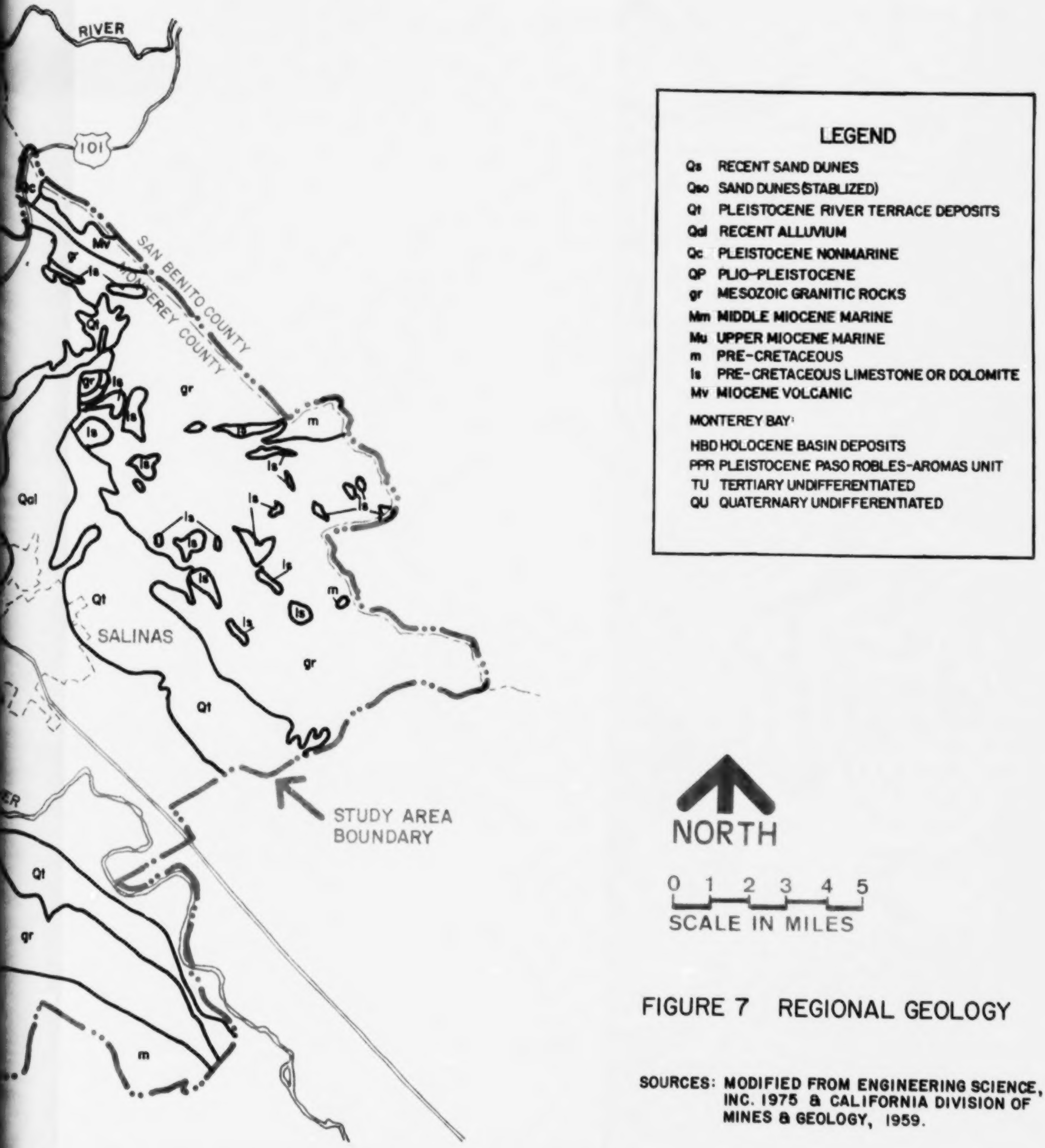


FIGURE 7 REGIONAL GEOLOGY

SOURCES: MODIFIED FROM ENGINEERING SCIENCE, INC. 1975 & CALIFORNIA DIVISION OF MINES & GEOLOGY, 1959.

The coastal portions of the study area are underlain chiefly by Recent sand dune and alluvial deposits. The Monterey Peninsula, however, is geologically complex with basement granitic and marine sedimentary rock interspersed with Quaternary non-marine terrace deposits and Recent sand dunes (Jennings and Strand,1959).

Monterey Bay itself is underlain by several sedimentary deposits including Miocene mudstone (Monterey formation); Pleistocene red sand, gravel and clay tuff (Paso Robles-Aromas unit); and Recent (Holocene) deltaic deposits at the mouth of the Salinas River. In contrast, the bay bottom just offshore from Pacific Grove is composed of Mesozoic granite (Greene, 1970).

Seismic Features.

Faulting Hazards. California's central coast is an extremely active seismic area. The study area lies between two major fault zones -- the San Andreas to the east and the Sur-Nacimiento to the west. Within this belt are numerous smaller faults, both paralleling and transecting the major mountain ranges (see Figure 8).

Most of the earthquake *epicenters* mapped in the study area by the U. S. Geological Survey (Greene, et.al., 1973) are associated with the San Andreas fault zone, which borders the eastern base of the Gabilan Range and is about 13 miles northeast of Salinas. The Sur-Nacimiento fault zone lies offshore about 10 nautical miles southwest of Monterey, but few quakes have been associated with it since epicenter locations were first accurately mapped by the California Department of Water Resources in 1926.

Several faults between these two major zones are considered seismically active. The Palo Colorado-San Gregorio fault zone which is slightly inshore from the Sur-Nacimiento as it crosses Monterey Bay, is described as active by both Burkland and Associates (1975) and the U. S. Geological Survey (see Table D-1). Recent study indicates that the Palo Colorado-San Gregorio may actually be linked to an extremely long, continuous central coastal fault stretching from Bolinas in the north to near Pt. Conception on the south. It is unclear whether the Palo Colorado-San Gregorio or the Sur-Nacimiento is part of this long fault system south of the study area where the two converge near Pt. Sur (Jennings, pers. comm.). If this is one continuous fault system, there is a greater chance of large magnitude quakes occurring along the coast than previously thought. The Monterey Bay fault zone is also considered

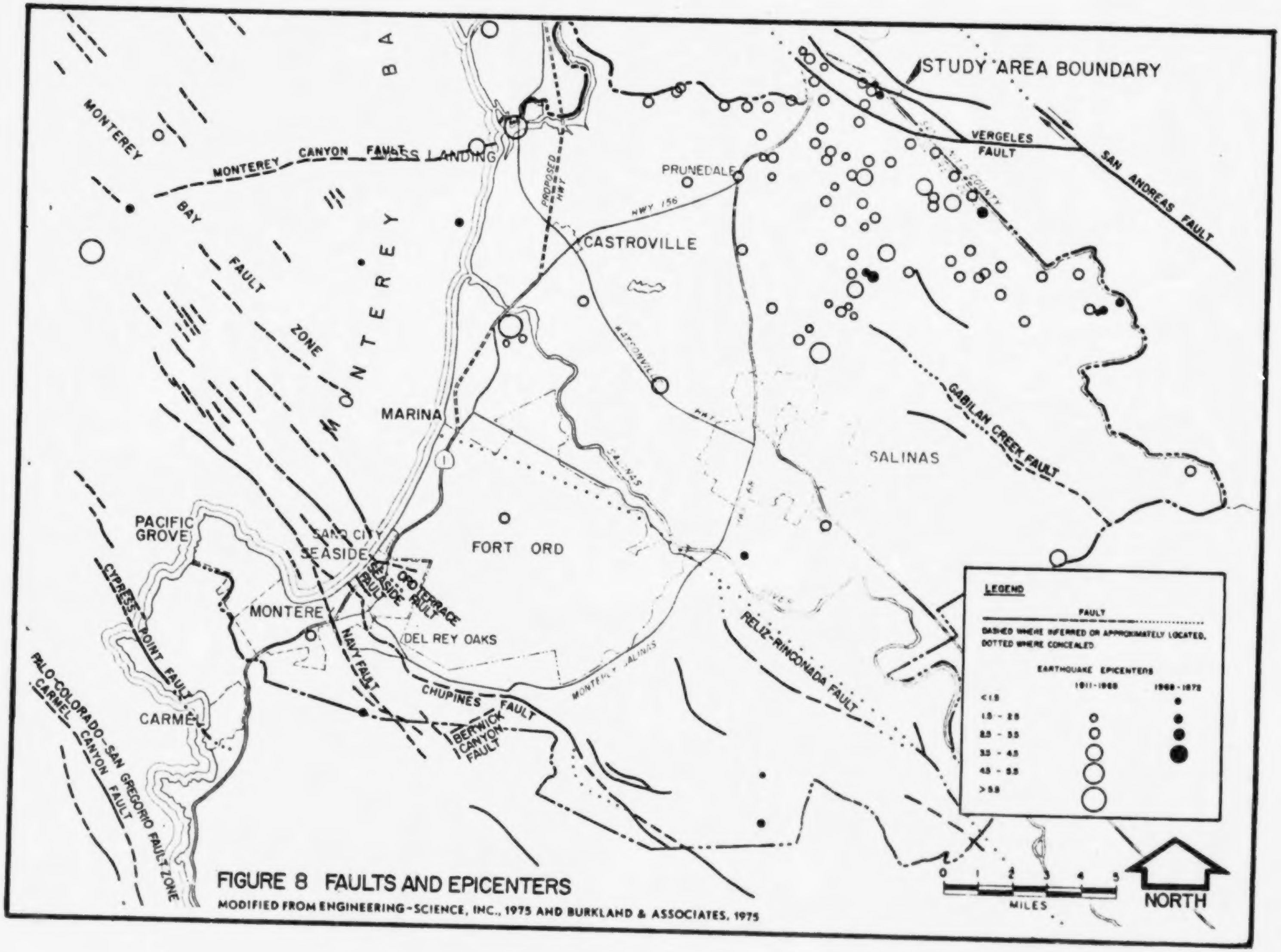


FIGURE 8 FAULTS AND EPICENTERS

MODIFIED FROM ENGINEERING-SCIENCE, INC., 1975 AND BURKLAND & ASSOCIATES, 1975 active. This series of short faults crosses the floor of the southern bay and may link with a series of other faults on the landward rim of the bay. Numerous earthquake epicenters have been mapped within or slightly seaward of the bay, including two of 6.1 magnitude (Richter scale) in 1926. Twenty-eight epicenters have been recorded in the vicinity since 1969 (Greene, et.al., 1973).

Several inland faults between Monterey and Seaside (the Navy, Berwick Canyon, Chupines, Seaside and Ord Terrace faults) appear to be extensions of the Monterey Bay northwest to southeast trending fault zone. Another inland fault, the Reliz-Rinconanda (King City fault in Greene, et.al., 1973), has acted as the offset plane between the Sierra de Salinas Mountains and the Salinas Valley. Since 1969 numerous small tremors have been recorded along this fault southwest of Gonzales (Greene, et.al., 1973), but it is listed as only potentially active by Burkland and Associates (1975). On the eastern side of the study area, there are only two significant faults in the Gabilan foothills -- the Gabilan Creek fault and the Vergeles, a branch of the San Andreas fault zone, both listed as potentially active by Burkland and Associates (1975).

Tsunami Hazard. Tsunamis (seismically-induced sea waves) can inundate low-lying coastal areas. Though the Elkhorn Slough-Moss Landing Harbor area, Monterey Harbor, and the Monterey Bay coastline in general have experienced minor tsunamis, there has been little or no damage and no loss of life. The U. S. Army Engineer Hydraulics Laboratory (Garcia & Houston, 1975) recently completed a detailed analysis of potential tsunami-induced wave runup in the Monterey Bay region. Their report indicates that the Aleutian trench is the only area likely to generate a tsunami with a once-in-one hundred year frequency rate capable of affecting the Monterey Bay area. Their calculations list the 100-year tsunami runup for the study area coastline to be between 5.9 and 7 feet above mean sea level (msl). This means simply that on the average, once in every 100 years a tsunami capable of inundating coastal areas up to 7 feet above mean sea level is likely to strike the Monterey Bay region. The 500-year frequency tsunami was calculated to have a runup of between 11.5 and 13.6 feet above msl in the study area.

The 100-year wave would have its most serious effect on persons and structures located at Moss Landing and Monterey Harbors. Boats, moorings and adjacent commercial-industrial buildings would be inundated and could receive major structural damage. Extensions of the runup through the Salinas and Pajaro Rivers and Elkhorn Slough were not calculated by the Army Engineers. Therefore, no estimate can be made of the potential hazard inland along these waterways.

Soils. The Report and General Soil Map - Monterey County, California (U.S. Department of Agriculture, Soil Conservation Service, 1968) presents general *soil associations* for the entire study area. A table of soil characteristics and qualities, from this report, is in Appendix C. More detailed data on soil types likely to be influenced by project features are in the Site-Specific Environment section. Soil associations are mapped in Figure 9.

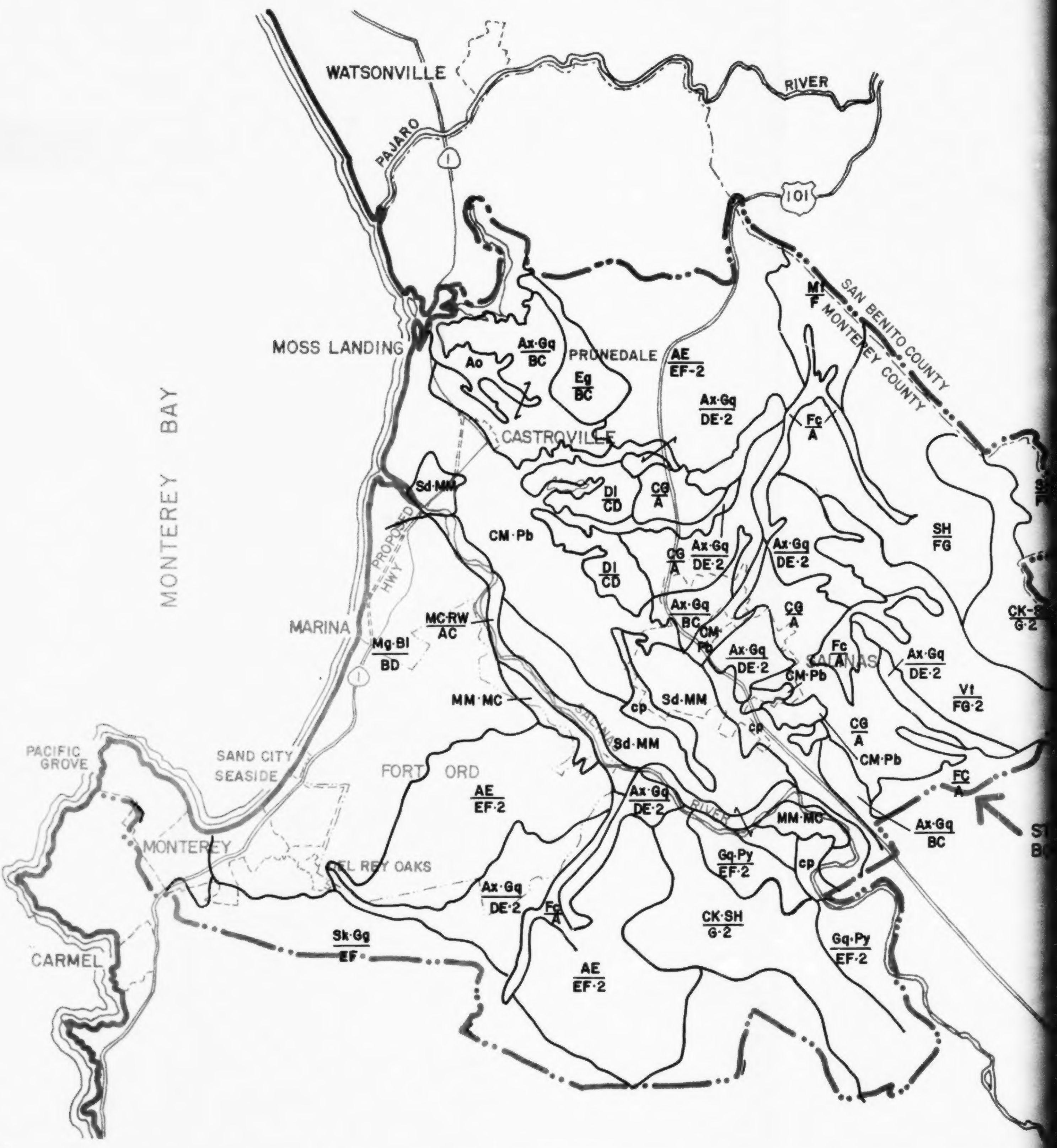
The Salinas River floodplain and the floodplains of the small creeks draining the Gabilan Range are covered predominantly by moderately deep to very deep, highly fertile soils (Cropley, Farallone, Metz, Mocho, Salinas, Clear Lake, and Pacheco soils). These soils support most of the study area's intensive agriculture, including row and field crops.

The soils covering the gently sloping *alluvial fans* and low terraces bordering the Salinas River floodplain are also valuable for production of row and field crops, but are slightly less fertile and have hard clay loam and silty loam subsoils, reducing *permeability* (Chualar and Farallone soils).

The high terrace lands and low rolling hills bordering the Salinas Valley and El Toro Creek are covered with coarser grained, well drained soils with hard clay subsoils. Although used for a variety of agricultural pursuits, including row crops, pasture and range, they are of marginal agricultural value because of their low fertility and significant erosion potential. Antioch, Gloria and Placentia soils are included in this group.

The upland soils of the Gabilan and Sierra de Salinas Mountains have formed mainly on granite base rocks and are therefore coarse grained and well to excessively drained. These generally shallow soils support rangeland, recreation, and wildlife; the steep slopes and erosion hazard limit other uses. Cieneba, Sheridan and McCoy soils are found over most of the Gabilan Range upland, while Vista and Sheridan soils are mapped in the Sierra de Salinas. The mountainous areas north of the lower Carmel River are formed on marine sediments rather than granite; the soils are therefore finer textured shalely loams and clay loams with less severe slopes and erosion hazard. Some dry-farmed crops are grown on these Santa Lucia and Gazos soils.

Soils along the study area's coastline are formed principally on marine sedimentary rocks and sand dune deposits. The Narlon association soils of the Monterey Peninsula are loamy fine sands with clay subsoils developed from coastal marine sediments. They typically support a dense woodland


WATSONVILLE
PAJARO
RIVER
1
101
MOSS LANDING
Ao
Ax·Gq/BC
PRUNEDALE
Eg/BC
AE/EF-2
Mf/F
SAN BENITO COUNTY
MONTEREY COUNTY
MONTEREY BAY
Ax·Gq/DE·2
CASTROVILLE
Fc/A
Sd·MM
DI/CD
CG/A
PROPOSED HWY
CM·Pb
SH/FG
DI/CD
CG/A
Ax·Gq/DE·2
Ax·Gq/DE·2
Ax·Gq/BC
CG/A
MARINA
MC·RW/AC
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Mg·Bl/BD
Fc/A
Ax·Gq/DE·2
SALINAS
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Sd·MM
cp
CG/A
SALINAS
PACIFIC GROVE
SAND CITY
SEASIDE
FORT ORD
Sd·MM
CM·Pb
FC/A
AE/EF·2
Ax·Gq/DE·2
RIVER
MM·MC
Ax·Gq/BC
MONTEREY
DEL REY OAKS
Gq·Py/EF·2
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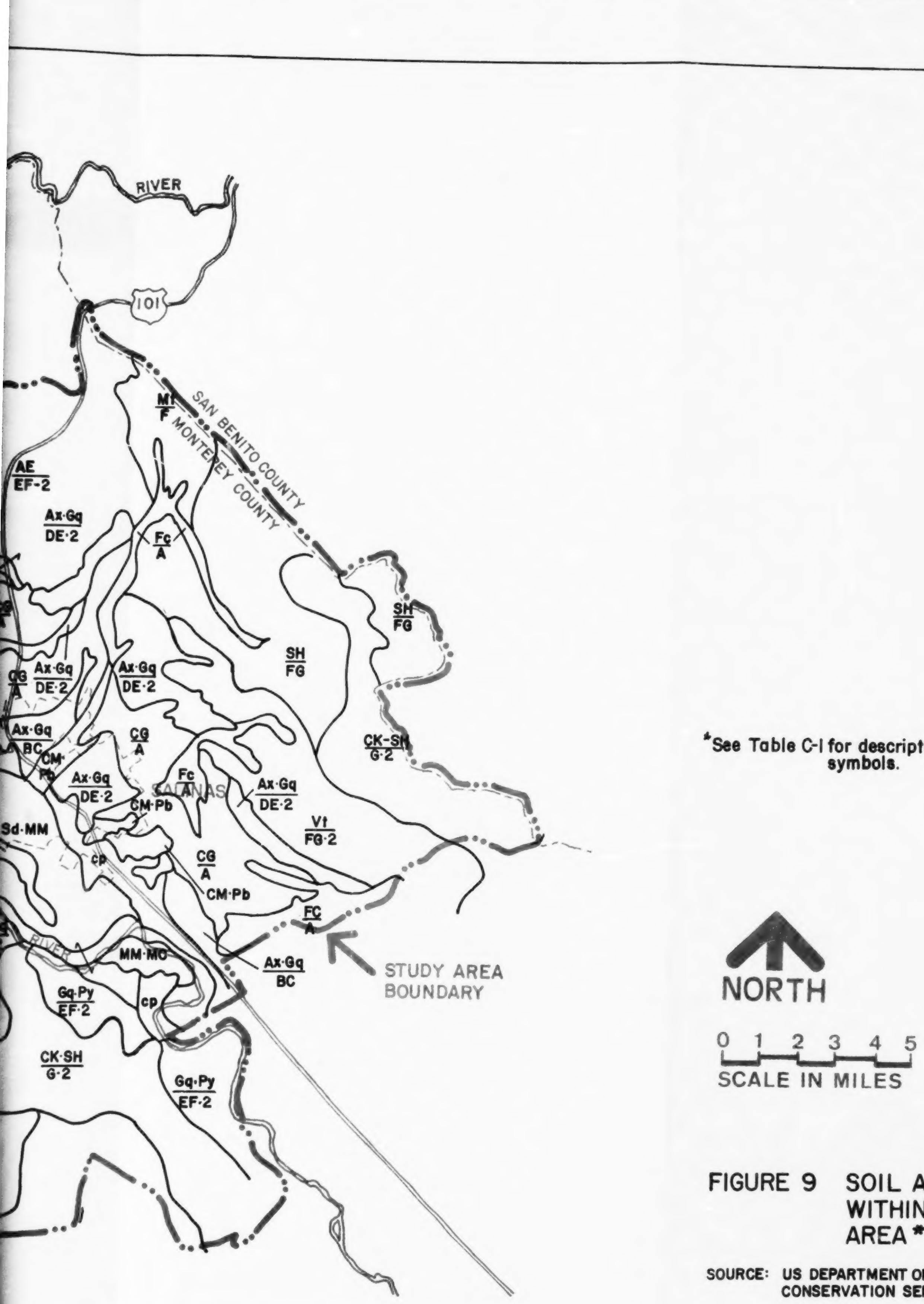
CARMEL
AE/EF·2



*See Table C-I for description of mapping symbols.

FIGURE 9 SOIL ASSOCIATIONS WITHIN THE STUDY AREA *

SOURCE: US DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, 1968.

but are now highly urbanized. Arnold and Marina-Baywood associations are mapped on the sand dune deposits occurring along the coast and inland from Monterey north to the mouth of the Salinas River. These soils are excessively drained, moderately erosive and extremely low in fertility. Most of them are either urbanized or within the Ft. Ord military post. They are of limited agricultural value.

Archeology. Only sites proposed for facilities construction were surveyed for archeological and historical resources. First, records of the Cultural Resources Section of the California Department of Parks and Recreation were searched (see Appendix F for a letter to the Department of Parks and Recreation). The National Register of the Historic Places was also checked. A literature search was made to identify additional archeologic/historic work of significance done within the study area.

All proposed alternative interceptor alignments and treatment plant sites as well as existing plant sites were then traversed on foot by a team of experienced archeologists. Ground surfaces were carefully examined for evidence of historic and prehistoric occupation or use. Where further definition was warranted, small trowel holes were dug to maximum depths of 25 centimeters (cm), and where cultural evidence was found, the locations were plotted on the appropriate USGS 7.5-minute topographic maps. One probable prehistoric site (JS-MP-1) was found near the Seaside treatment plant. A site survey form detailed critical data on artifacts and the extent and location of the site. The site covers about 30 meters by 30 meters and is on the western slopes of a small sand dune. Evidence of prehistoric habitation is sparse, but there is enough to consider it a site. Cultural material includes chert flakes, retouched flake scrapers, an obsidian flake, thermal fractured rock (broken cooking stone), shell fragments, and mammal bone fragments.

The presence of site JS-MP-1 is probably related to the availability of freshwater in the lagoons immediately to the south. Other sites may be present, but the unstable sand dunes have concealed any surface evidence of prehistoric occupation at alternative plant sites or along alternative interceptor routes.

The lack of sites in areas adjacent to the Salinas River on the secondary terraces (proposed interceptor alignments) cannot be explained. It may be that these areas were subject to periodic inundation and were considered uninhabitable by the Indian population.

Land Use

Agricultural. Outside the incorporated municipalities, a large portion of the study area's land is agricultural; 94 percent is categorized as either agricultural or vacant (Table 1 and Figure 10). The Salinas-Castroville area offers ideal growing conditions for artichokes, broccoli, cauliflower, celery and lettuce; strawberries are grown in the uplands. South of Salinas, further from the marine weather influence, carrots, beets, beans and tomatoes are grown in quantity. The Salinas Valley as a whole is one of the richest and most productive produce-crop areas in the United States.

Table J-5 shows agricultural production for Monterey County in terms of crop-acres, the number of acres producing crops. Since land is often double-cropped, crop-acres exceed physical land acreage.

Of the six major crops in the lower Salinas Valley, lettuce has historically been the most important. This crop accounted for 82 percent of crop-acres used for these six crop types in 1950; however, by 1974, lettuce had dropped to 53 percent. Other crops in this group -- artichokes, broccoli, cauliflower, celery and strawberries -- have become increasingly important over time, with crop-acreage increasing by factors of 2 (artichokes), 3 (broccoli and strawberries) and 5 (celery); cauliflower crop-acres have increased from a mere 250 in 1950 to over 9,000 in 1974.

The value of these crops (stated in Table J-6, using 1975 dollars for easy comparison) shows that the six principal crops increased in value 127 percent between 1950 and 1970, and 173 percent between 1950 and 1974, despite a rise in crop-acres of only 50 percent.

Open Space. Open space is provided by numerous public and private recreational lands in addition to agriculture within the study area.

State parks and beaches cover 441 acres. They include Monterey, Salinas River, and Zmudowski State Beaches, and Fremont Peak, Jetty Beach and Asilomar Beach State Parks. There are four regional parks (Toro, Jack's Peak, Laguna Seca Recreation Area, and Salinas River Recreation Area) and over 240 acres of municipal parks (Monterey County Transportation Study, 1974). The California Department of Fish and Game manages an 800-acre Wildlife Area (acreage includes part of the bay and the lagoon) near the mouth of the Salinas River that is also open to the public. Numerous public and private golf courses (15 in the county) offer additional open space.

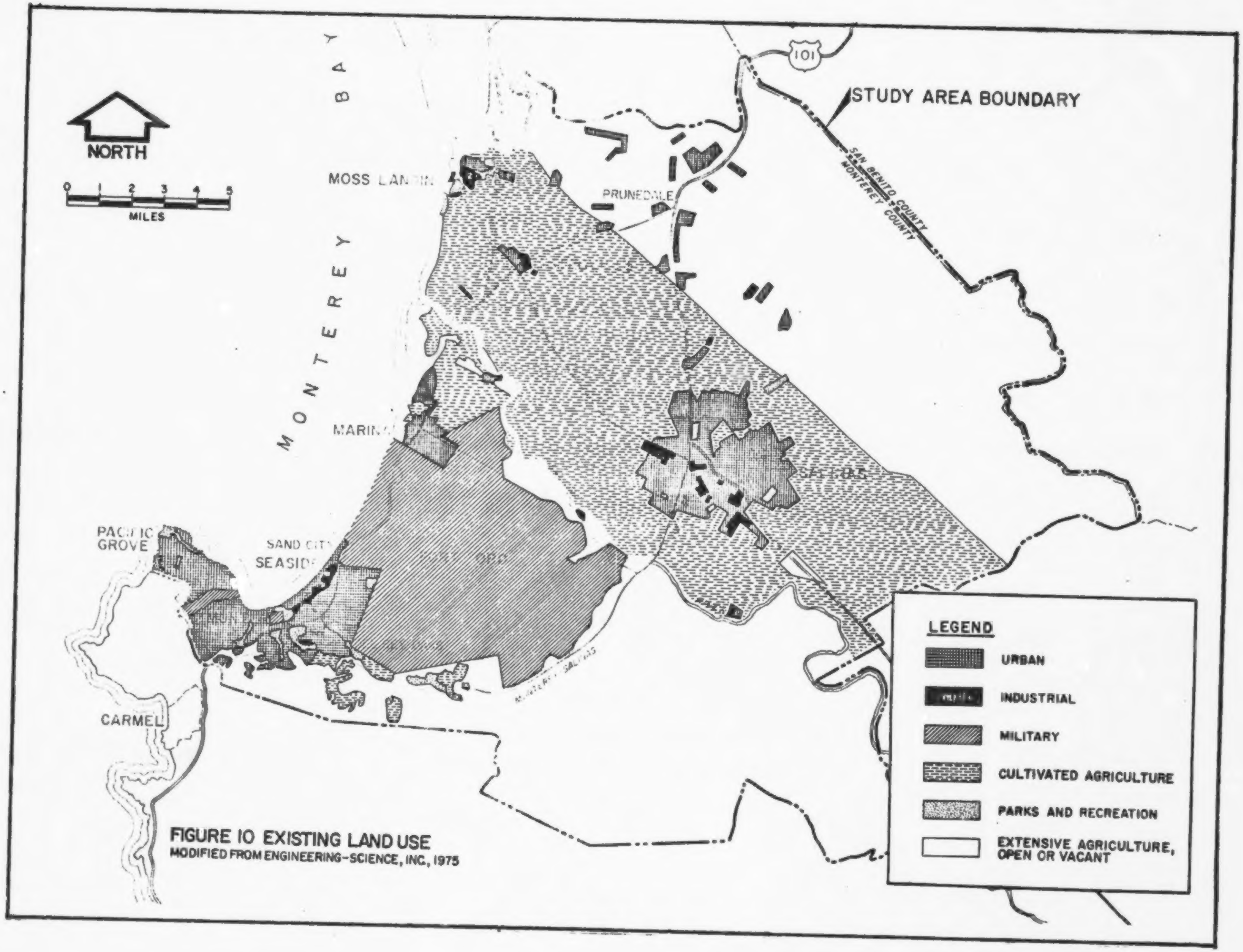


FIGURE 10 EXISTING LAND USE
MODIFIED FROM ENGINEERING-SCIENCE, INC, 1975

TABLE 1

Study Area Land Use Inventory, 1974
(in acres)

Category	Del Rey Oaks	Monterey	Pacific Grove	Salinas	Sand City	Seaside	Total Incorporated	Unincorporated	TOTAL	% of Study Area
Residential	123	1,161	818	2,512	7	874	5,495	12,502	17,997	.9
Commercial	8	262	104	698	3	146	1,231	897	2,128	.1
Industrial & Utilities	1	96	9	334	38	6	484	13,263	13,747	.7
Transportation	66	1,135	410	1,983	91	468	4,153	15,219	19,372	.9
Public & Institutional	47	1,246	319	884	1	4,245	6,742	78,954	85,696	4.2
Total Developed	245	3,900	1,660	6,411	140	5,749	18,105	120,835	138,940	6.8
Agricultural,* Vacant & Other	50	1,201	23	2,327	207	122	3,930	1,911,667	1,915,597	93.2
TOTAL	295	5,101	1,683	8,738	347	5,871	22,035	2,032,502	2,054,537	

* For the purposes of Monterey County Transportation Study, there was no need to separate agricultural and vacant land.

Source: Monterey County Transportation Study, 1974.

Circulation Network. In Monterey County there are 2,103 miles of roads and streets, of which 301 are state highways, 1,330 are county roads, and the rest city streets (Alan M. Voorhies & Assoc., Inc., 1975). Transportation services and the circulation pattern in the study area are described in the Public Services and Facilities section.

Harbors. The harbors at Monterey and Moss Landing have both commercial and recreation fleets, with more commercial than recreation craft. Commercial fleets are expected to remain the same size or decline while there will be more pleasure craft (Monterey County Transportation Study, 1973). In 1975, Monterey Harbor had 405 berths and Moss Landing 400.

Military. Fort Ord, a major installation of the U.S. Army, is in the study area, and occupies 28,700 acres. The base is being changed from a training facility to a division headquarters, and residential housing will soon be added at the rate of 350 units a year, with a final total of 1,000 new units and a base population not exceeding 25,000 by 1995. (Because of changing military requirements, population predictions may also change.)

Other military facilities are the Presidio and the Naval Postgraduate School at Monterey. The Army's Defense Language Institute is at the Presidio.

Urban. Population of the study area is now about 193,000. Even though agriculture is the basis of the economy, urbanization is increasing.

URBANIZATION TREND IN STUDY AREA

	% of Population in Cities	# of Cities
1950	46	3
1960	56	5
1970	73	6
1975	84	7

Source: U. S. Census of Population: 1950, 1960, 1970; State of California, Department of Finance Population Estimates, 1975.

In the 1970 census, Seaside-Monterey had become an "urbanized area" with a population of 93,553. By adding the 1970 population of Salinas, the urban population of the study area was about 152,500, or over 80 percent of the total population. Figure 9 is a map of the Seaside-Monterey and Salinas urbanized area as of the 1970 census.

Though there has been a gradual conversion of agricultural land to urban use, the amount of land under cultivation has not declined; marginal land is constantly being added to the cultivated acreage, and agricultural production has increased, as already reported.

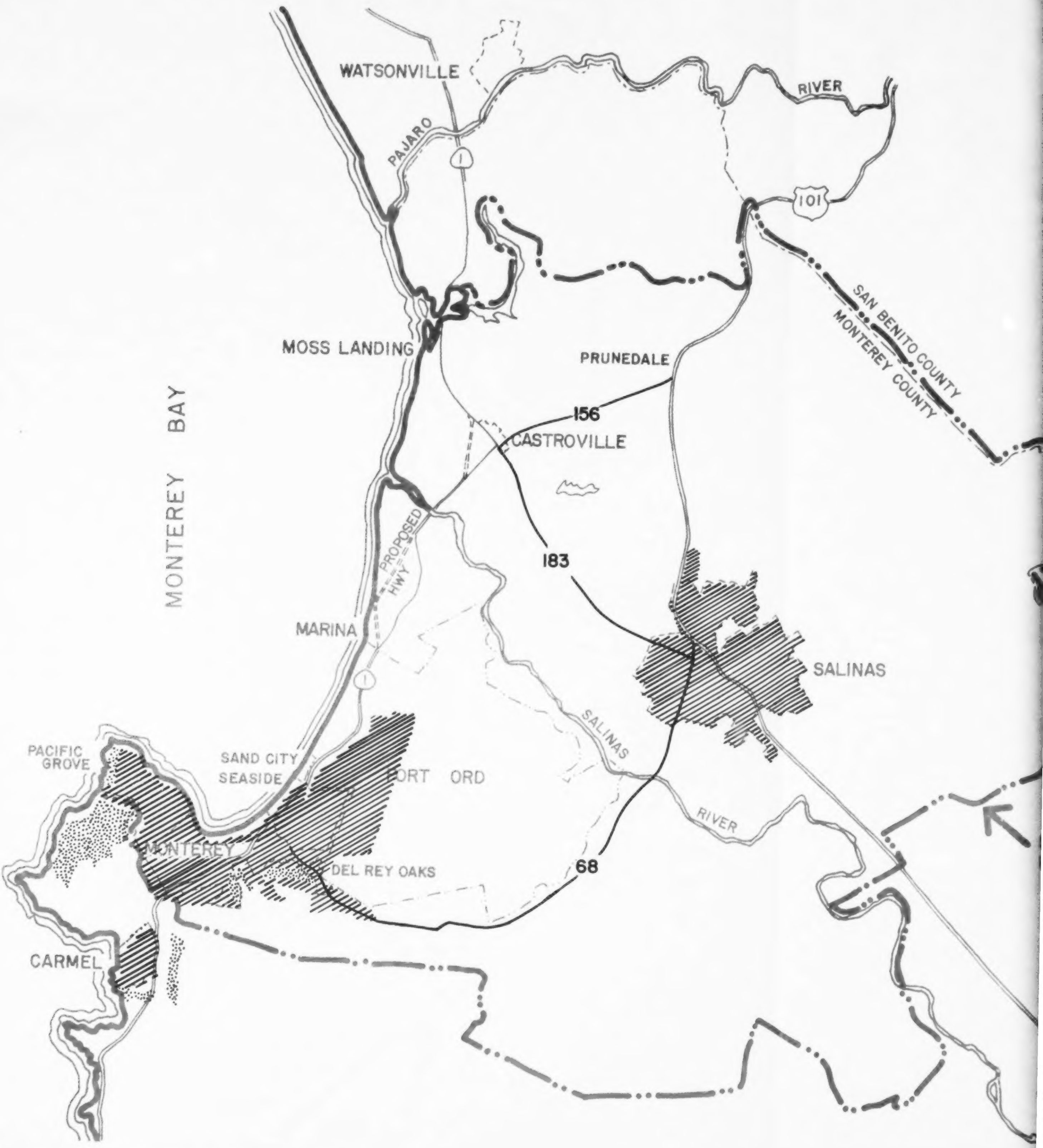
Land use changes between 1970 and 1974 were tabulated by the Monterey County Transportation Study. This work, as summarized in the Basis of Planning Report (Engineering Science, Inc., 1975), indicates that much new residential development was taking place on land classified as "vacant" suggesting that residential development is taking place predominantly in undeveloped areas rather than as infill in areas in which a pattern of residential use has already been established. This interpretation must be qualified, however, because it is not known whether small vacant lots were counted into the total vacant category in urban areas. "Vacant" in the MCTS breakdown includes undeveloped land both inside and outside of urban areas.

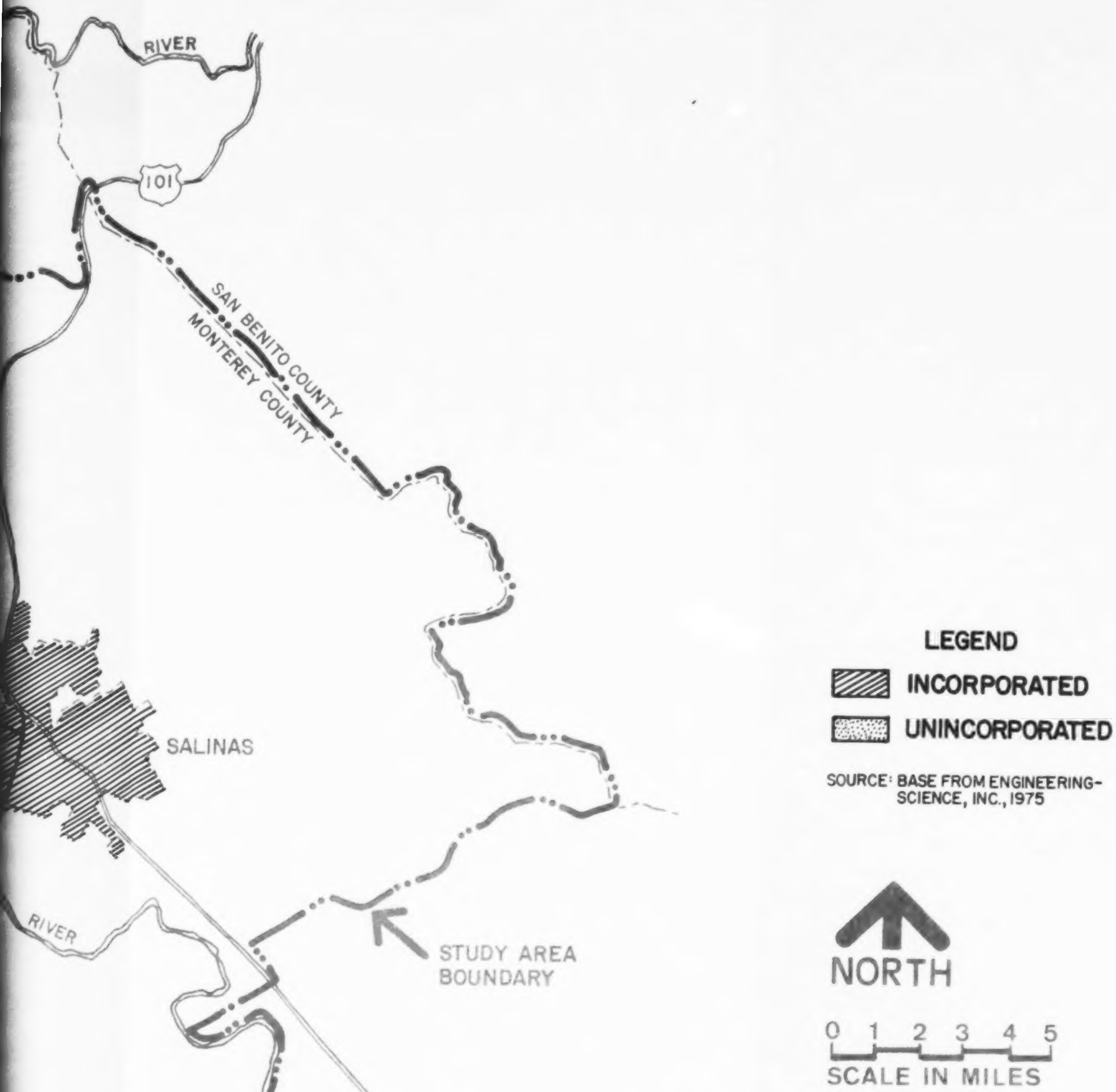
Table 1 gives acreage by land use categories in civil jurisdictions of the study area, showing the variations in different communities.

Annexations as well as residential, commercial and industrial development are anticipated in the project study area in the future. However, the current moratorium on water connections in Seaside, Monterey and Pacific Grove has affected development in these areas. Marina (which has a population of about 10,500 in the settled part) has a moratorium on new sewer connections which will not be lifted until the current sewer treatment expansion program is completed.

Flood Hazard. A problem affecting current land use in the study area is flooding. Even after the construction of three major dams, there was serious flooding along the entire Salinas River in February 1969. There is periodic flooding along the lower river floodplain and the river's eastern tributaries. Figure 12, prepared by Engineering Science, Inc. from U. S. Geological Survey maps, outlines the 100-year flood area (the area expected to be flooded by high flow volumes likely to occur only once in 100 years).

The U. S. Army Corps of Engineers is now re-evaluating data to better understand the flood problem. Table 5 in the Surface Water Quantity and Quality section lists average and maximum monthly flows for the Salinas River at Spreckels.


WATSONVILLE
PAJARO
RIVER
1
101
SAN BENITO COUNTY
MONTEREY COUNTY
MOSS LANDING
PRUNEDALE
MONTEREY BAY
156
CASTROVILLE
PROPOSED HWY
183
MARINA
SALINAS
1
PACIFIC GROVE
SAND CITY
SEASIDE
FORT ORD
SALINAS
RIVER
MONTEREY
DEL REY OAKS
68
CARMEL



SOURCE: BASE FROM ENGINEERING-SCIENCE, INC., 1975

FIGURE 11 SEASIDE-MONTEREY & SALINAS URBANIZED AREAS, 1970.

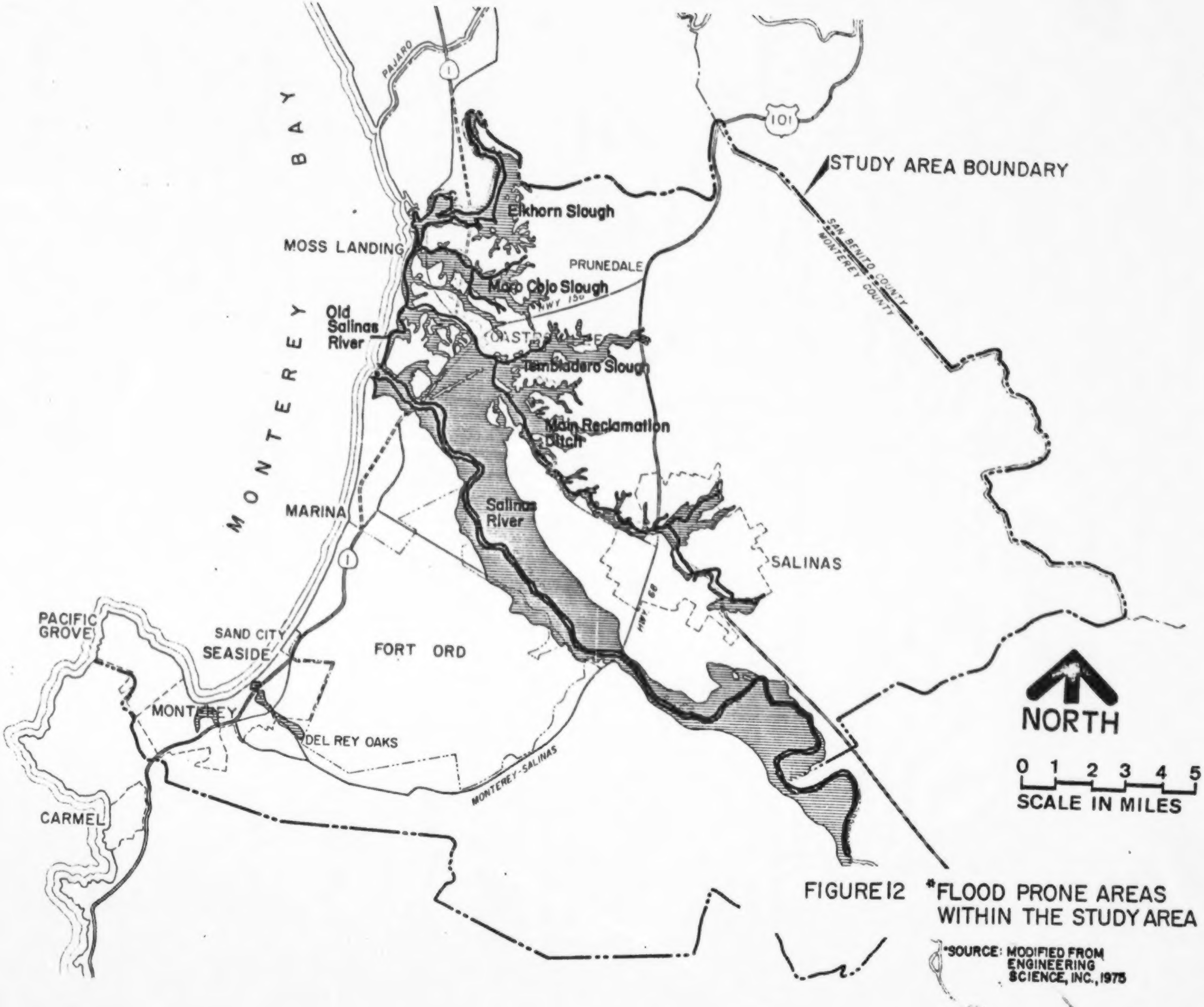


FIGURE 12 *FLOOD PRONE AREAS WITHIN THE STUDY AREA

*SOURCE: MODIFIED FROM ENGINEERING SCIENCE, INC., 1975

Three county-designated flood districts overlay established zoning in unincorporated areas and regulate land use in flood-prone areas. Proposed land use changes in these county flood districts are reviewed by the County Planning Commission with the help of the Monterey County Flood Control and Water Conservation District to determine the appropriateness of the use. Construction within the primary floodplain is limited to: 1) agriculture, or 2) other uses permitted by the zoning designation which is combined with the floodplain district, assuming the property within the floodplain district is protected by man-made dikes or levees. Development within the secondary floodplain district is restricted to agriculture, recreational use or other uses permitted by the overlying zoning as long as habitable floor levels of structures are above flood profile level or the structures are protected by man-made levees or dikes.

The unincorporated sections of the study area are not currently enrolled in a federal flood control program. The Federal Insurance Administration must first certify detailed flood hazard mapping of the area so that flood insurance availability and rates can be determined. The county must then submit their floodplain development control procedures in order to be part of a federal flood control program. Once the mapping is approved, federal financing of development within the flood hazard area can be withheld until the county is enrolled in an approved flood control program. Until the detailed mapping is complete, however, there are no federal sanctions on development in flood hazard areas. The detailed mapping will not be completed until late 1979 or early 1980.

The incorporated Cities of Monterey, Pacific Grove, Seaside and Salinas are presently participating in federally-approved flood control programs; Sand City, Del Rey Oaks and Marina are not.

Land Use Planning

The Planning Context. Planning is done by many levels of government and carried out by a variety of agencies with specific responsibilities. Several planning bodies in the study area are regional. The Association of Monterey Bay Area Governments (AMBAG) was originally formed to arrive at a comprehensive regional water quality management plan. See page 339 for an explanation of AMBAG's current planning responsibilities relating to water quality control in the study area. Similarly, the Salinas-Monterey Area Transportation Study (SMATS) answered the need for interjurisdictional transportation planning; this agency was succeeded by one covering the entire county, the Monterey County Transportation Study (MCTS). The Monterey Peninsula Water

Pollution Control Agency (whose members are Monterey, Pacific Grove, Salinas, Monterey County, and the Seaside County Sanitation District) acts as a subregional planning and implementation agency for wastewater districts. Finally, the Coastal Zone Conservation Commission, whose plan was submitted to the state legislature on December 1, 1975 (parts of the plan were subsequently incorporated into the California Coastal Act of 1976), is the body with the broadest jurisdiction in the study area. A description of the Commission's impact upon planning in the study area appears in the Legal, Regulatory and Institutional Constraints section.

Local Plans. State law requires each local general purpose government to prepare a comprehensive plan which must include specific "elements" such as land use, housing, and seismic safety. Capital improvement programs and local zoning implement such plans.

Monterey County. The General Plan of Monterey County, approved in 1968, established guidelines for growth, future land use, and elements for circulation, conservation, open space, ocean resources, public facilities, and economic activity. Emphasis is placed upon protecting the shoreline and providing access to it by carefully controlling development along the oceanfront and encouraging public acquisition of waterfront acreage.

City of Monterey. Planning in Monterey began early in the century. The city is currently revising its general plan. A major concern is to control growth by reviewing development proposals for overall impact. The city will continue to encourage new clean industry. (Fell, pers. comm.)

Pacific Grove. Pacific Grove formed its first planning commission in 1929. Its General Plan emerged in 1973. Pacific Grove expects to keep its residential character, with limited commercial activity for residents and visitors. Industrial development will be discouraged.

Salinas. Salinas began municipal planning in 1924. Changing attitudes toward future growth have made revision of the general plan necessary. Seven interim policies were articulated in 1973; they show a desire to limit sprawl and revitalize the downtown area.

Seaside. Seaside incorporated in 1954 in order to have more control over community development. Its general plan, now being revised to conform with state guidelines, includes a social element, a community facilities element, and a social service element (Burris, pers. comm.).

Marina. Marina voted to become a city in November 1975. The city has just begun working on a general plan. Goals and policies have yet to be articulated.

Castroville. Although Castroville is an old community it has not yet incorporated. It was not included in the precise zoning districts of the county zoning ordinance, and had no comprehensive plan until it was covered by interim county plans in 1956 and 1964. In 1973 the county, with the help of a citizen committee, produced the Castroville General Plan. The plan states that future growth should take such form as not to encroach upon prime agricultural land. The plan also emphasizes that the "preservation and retention of all existing sloughs, beaches and coastline is essential for the conservation of valuable fish and wildlife habitat".

Moss Landing. Moss Landing was included in the two interim plans mentioned above, and is now covered by a regional element of the County General Plan. The goals of the element outline a desire to preserve and protect the "prime and productive agricultural lands of the planning area". The element states that the shoreline should be protected and access to it provided and also stresses that "conservation of the Elkhorn Slough as a wildlife and estuarine resource is highly desirable".

Planning is discussed further in the Site Specific Environment section.

Air Resources

Meteorology. Typically, the Monterey Bay area has warm, dry summers and cool, rainy winters. The Pacific Ocean moderates extreme temperatures along the coast, but this influence diminishes inland, especially where mountains form a barrier to on-shore ocean breezes.

During the summer months when the North Pacific high pressure cell is located almost due west of Monterey, days are generally warm, sunny and dry. Coastal morning and evening fog is occasionally drawn up the Salinas Valley, but inland areas are usually clear and warm. Average July and August temperatures in Salinas are around 63°F, while on the coast at Monterey they remain close to 60°F (Engineering Science, Inc., 1975). Precipitation in these months is usually less than 0.1 inch.

During the fall, the oceanic high pressure cell begins to shift southward and on-shore breezes decline. This reduces the influx of fog and the area has warm, pleasant weather. As the high pressure cell shifts farther south, cyclonic storms from the Aleutian low pressure region begin to pass over northern California, bringing rain and gusty west winds. Average temperatures drop to the middle and low 50's (°F) during the winter. Ninety percent of the area's rainfall occurs between November 1 and April 30 (average annual rainfall is 18.5 inches in Monterey and 13.7 inches in Salinas). The warming effect of the Pacific Ocean maintains temperatures above freezing except for a few days each winter, when Arctic air invades California.

In March and April, the cool, wet days are interrupted by occasional warm, sunny days. The Pacific high begins to move north again and blustery west winds are frequent. May and June bring a return to warm sunny days and the return of summer coastal fog.

Local topography has a strong influence on precipitation. Rain falls on the western and southern slopes of the coastal hills. Leeward mountain slopes and the interior valleys (i.e., Salinas Valley) have considerably less rain. A table of average monthly temperatures and precipitation is in Appendix B.

The general wind pattern includes predominantly west and northwest winds averaging 4-8 mph in the spring and summer, with more variable breezes of 4-6 mph in the late fall and winter. Data collected at the Monterey-Salinas Airport just east of Monterey from 1949 to 1969 shows west and northwest winds blow in this area from March to October, with highest average wind speeds recorded in March, April and May (8.1 mph is the highest mean wind speed). From November through February winds from the southwest and southeast become common, reflecting the frequent passage of cyclonic storms moving from west to east across the state (Renaud, pers. comm.).

In the Salinas area, the natural configuration and orientation of the valley influences the wind pattern. Yearly average wind speed and direction data compiled by the National Weather Service show northwest (up-valley) and southeast (down-valley) winds are the most frequent at Salinas, with highest average wind speeds coming from the southeast at 11.1 mph

(Abercrombie, pers. comm.). The 3,000-foot mountain barrier on either side of the valley (created by the Sierra de Salinas and the Gabilan Range) act in concert with low inversion heights to prevent the direct inflow of marine air except through the valley opening onto Monterey Bay. The result is a pronounced channelization of winds. In the Paso Robles area, winds are light to variable 29 to 55 percent of the time. This, coupled with relatively low nighttime inversion conditions, tends to encourage the accumulation of air pollution in the southern part of the Salinas Valley (Stanford Research Institute, 1958). Annual wind speed and direction data for Monterey, Salinas, Paso Robles and Hollister are shown in Appendix B.

Air Quality. The air quality of an area is affected by the types and amounts of pollutants emitted into the atmosphere, physical processes (meteorology) affecting the distribution of these pollutants, and chemical reactions involving pollutants and substances naturally present in the atmosphere. Appendix A-1 provides a background discussion of air pollution terminology, meteorological and chemical processes important to an understanding of air pollution, and the various types of effects produced by air pollutants.

Air Quality Management. Air quality management responsibilities exist at local, state and federal levels of government. State legislation enacted in 1947 authorized each county to form a local air pollution control district. In 1970, legislation was enacted which made it mandatory for each county to be within such a district. Local air pollution control districts have primary responsibility for the control of stationary sources of air pollution. Local air pollution control district regulations establish limitations on the quantities of air pollutants which may be emitted by various types of pollution sources. In addition, air pollution control districts have permit authority over the construction and operation of new stationary sources of air pollution. Permits for such new sources can be denied if emissions from that source would either exceed local emissions limitations or result in violation of any ambient air quality standard.

Control of mobile sources of air pollution is exercised at state and federal levels. The California Air Resources Board (ARB) and its predecessor agencies have required a series of emission control devices on vehicles sold in California.

Statewide ambient air quality standards were first authorized in 1959. The 1967 Mulford-Carrel Act, which created the California Air Resources Board, also authorized the ARB to adopt air quality standards, designate air basins, establish motor vehicle emission standards, monitor air pollutants, and exercise control over stationary sources of air pollution if the local air pollution control district's activities are insufficient to achieve air quality standards.

The California Air Resources Board has divided the state into 14 air basins. The study area is part of the North Central Coast Air Basin, which consists of Santa Cruz, Monterey and San Benito Counties. While air pollution problems are recognized in this air basin, they are significantly less serious than those found in most of the more populous basins in the state. The three counties which comprise the North Central Coast Air Basin have recently merged their air pollution control functions in the Monterey Bay Unified Air Pollution Control District.

Federal ambient air quality standards were first authorized by the Clean Air Act amendments of 1970. State ambient air quality standards take precedence over the federal standards only in cases where the state standards are more stringent.

Table 2 presents ambient air quality standards which have been adopted by the California Air Resources Board and the U. S. Environmental Protection Agency. These standards are based on numerous studies of the health-related and other effects of air pollutants. Two sets of federal standards have been adopted. The "primary standards" identify ambient air quality levels necessary to protect public health "with an adequate margin of safety". The "secondary standards" identify ambient air quality levels necessary to protect "public welfare", such as prevention of air pollution damage to crops, natural vegetation, materials and structures. The adopted state and federal air quality standards are based on available research regarding the effects of various levels of each pollutant. The federal standards, for example, are based largely on data summarized in the Air Quality Criteria documents published by the U. S. Department of Health, Education and Welfare in 1969 and 1970. The adequacy or necessity for these standards has been the subject of substantial controversy. A recent evaluation of the federal primary ambient air quality standards by the National Academy of Sciences for the U. S. Senate concludes:

Table 2

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards[1]		National Standards[2]		
		Concentration[3]	Method[4]	Primary[3, 5]	Secondary[3, 6]	Method[7]
Oxidant (Ozone)	1 hour	0.10 ppm (200 ug/m^3)	Ultraviolet Photometry	160 ug/m^3 (0.08 ppm)	Same as Primary Std.	Chemiluminescent Method
Carbon Monoxide	12 hour	10 ppm (11 mg/m^3)	Non-Dispersive Infrared Spectroscopy	—	Same as Primary Standards	Non-Dispersive Infrared Spectroscopy
	8 hour	—		10 mg/m^3 (9 ppm)		
	1 hour	40 ppm (46 mg/m^3)		40 mg/m^3 (35 ppm)		
Nitrogen Dioxide	Annual Average	—	Saltzman Method	100 ug/m^3 (0.05 ppm)	Same as Primary Standards	Proposed: Modified J-H Saltzman (O_3 corr.) Chemiluminescent
	1 hour	0.25 ppm (470 ug/m^3)		—		
Sulfur Dioxide	Annual Average	—	Conductimetric Method	80 ug/m^3 (0.03 ppm)	—	Pararosaniline Method
	24 hour	0.04 ppm (105 ug/m^3)		365 ug/m^3 (0.14 ppm)	—	
	3 hour	—		—	1300 ug/m^3 (0.5 ppm)	
	1 hour	0.5 ppm (1310 ug/m^3)		—	—	
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m^3	High Volume Sampling	75 ug/m^3	60 ug/m^3	High Volume Sampling
	24 hour	100 ug/m^3		260 ug/m^3	150 ug/m^3	
Sulfates	24 hour	25 ug/m^3	AIHL Method No. 61	—	—	—
Lead	30 Day Average	1.5 ug/m^3	AIHL Method No. 54	—	—	—
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m^3)	Cadmium Hydroxide Stractan Method	—	—	—
Hydrocarbons (Corrected for Methane)	3 hour (6-9 a.m.)	—	—	160 ug/m^3 (0.24 ppm)	Same as Primary Standards	Flame Ionization Detection Using Gas Chromatography
Ethylene	8 hour	0.1 ppm	—	—	—	—
	1 hour	0.5 ppm				
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility to less than 10 miles when the relative humidity is less than 70% (8)		—	—	—

NOTES:

1. California standards are values that are not to be equaled or exceeded.
2. National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.
3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
4. Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.
5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).
6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by the EPA.
7. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.
8. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

Source: Air Resources Board, 1976.

> "Due to the limitations of present knowledge, it is impossible at this time to establish an ambient air concentration of any pollutant — other than zero — below which it is certain that no human beings will be adversely affected.
>
> "Present knowledge of health effects appears to afford no compelling basis for suggestions to either raise or lower the currently mandated primary air quality standards at this time.
>
> "The present standards rest upon the best judgments which could be made of effects observed under far from ideal observing or experimental conditions. The impressions gained from the collective presentations and attitudes of those who participated in the conference is that, from the standpoint of health considerations, it would be prudent to retain the present standards until a substantial body of research provides much better evidence than any currently available to indicate that the primary air quality standards should be either relaxed or made more stringent. This conservative view is fostered by emerging data that suggest that observed adverse health effects may arise in considerable part not only from interactions of body tissues with the primary pollutants but with unidentified reaction products generated by complex chemical events in the atmosphere or indeed within the lung." (National Academy of Sciences, 1973)

The 1970 amendments to the federal Clean Air Act transferred the air pollution control activities of the federal government to the Environmental Protection Agency (EPA). The Clean Air Act authorized EPA to establish national air quality standards, to establish emission standards for various stationary and mobile sources of pollutants, and to require all states to develop and adopt plans (implementation plans) to achieve and maintain these standards by July of 1975. The Clean Air Act contained provisions allowing EPA to grant time extensions of up to 2 years for the attainment of selected air quality standards in specific regions. No such time extensions were applied to the North Central Coast Air Basin. EPA guidelines require that state implementation plans must provide for emission limitations; land use and transportation controls; source monitoring; ambient air quality monitoring; inter-governmental cooperation; and a procedure for review and approval of new sources of air pollution prior to construction. EPA has the authority to approve or disapprove these plans, and to promulgate an acceptable plan if the submitted plan is disapproved.

California's implementation plan (California Air Resources Board, 1972) was submitted in 1972. Since that time, five major revisions have been adopted by ARB and submitted to EPA. Portions of California's implementation plan have failed to receive EPA approval. The issues in question involve the failure of the California plan to demonstrate a means of achieving the national air quality standards in all air basins by the adopted attainment deadlines; failure to provide for maintenance of air quality in "clean air areas" or in other areas once the standards are attained; and a failure to incorporate adequate land use and transportation control measures.

Revision 5 to the California Implementation Plan (California Air Resources Board, 1974f) recommended that EPA designate Monterey County as an air quality maintenance area with respect to photochemical oxidants. Air quality maintenance areas are those areas which either a) currently exceed one or more national air quality standards and are not expected to achieve the national standard by 1980; or b) currently meet all national air quality standards but are expected to exceed one or more standards by 1985. Such a designation requires that detailed projections of future pollutant levels be prepared for each area designated as an air quality maintenance area. If this analysis confirms that a national air quality standard will not be maintained through 1985 or achieved by 1980, development of a long-term maintenance plan may be required to assure the earliest feasible achievement and subsequent maintenance of the air quality standards of concern.

Subsequent to publication of Revision 5 to the California Implementation Plan, new procedures for monitoring oxidant levels were adopted by the California Air Resources Board (Appendix A-2). These new procedures produce readings about 20 percent lower than those produced by the previous ARB methodology. In addition, the Monterey Bay Unified Air Pollution Control District presented ARB with revised information on current and historical hydrocarbon emissions, and a program for significantly reducing these emissions. On the basis of this information, ARB withdrew its recommendation that Monterey County be designated an Air Quality Maintenance Area. Both ARB and EPA are continuing to evaluate the current and expected air quality conditions in Monterey County. The county could be designated as an AQMA if warranted by this ongoing evaluation.

In September 1976, ARB released a report outlining a proposal to establish an Air Conservation Program in California (California Air Resources Board, 1976d). This program is designed to meet EPA "no significant deterioration" regulations for existing "clean air areas" as well as state legislative mandates to protect and enhance air quality throughout the state. The program as outlined in preliminary form would classify all areas of the state into one of four categories: areas in which no deterioration of existing superior air quality would be allowed; areas where a certain amount of deterioration from existing air quality levels would be allowed, but which would maintain air quality superior to existing health-related standards; areas in which air quality standards to protect agricultural productivity would be met; and areas where existing health-related standards are adequate as air quality goals. The details of such an air conservation program are expected to be developed during the next two years.

Present Air Quality of the Study Area. Table 3 shows the frequency with which state and federal standards for oxidants have been exceeded at monitoring stations in the district, and Table 4 shows unacceptable particulate levels. Carbon monoxide, nitrogen dioxide and sulfur dioxide measurements have not exceeded state or federal standards. Appendix A-4 provides more detailed data on ambient air quality measurements in the North Central Coast Air Basin. In general, oxidant levels in the basin reach periodic high levels between March and October (Figure 13). Periodic high levels for carbon monoxide, nitrogen oxides, hydrocarbons, and lead particulates occur from September through February. No seasonal trend is evident for suspended particulates.

Appendix A-3 provides data on the quantities of air pollutants emitted by various stationary and mobile sources within the district in recent years. The major increase between 1973 and 1974 in organic compound emissions from petroleum production in Monterey County reflects a more accurate estimate of emissions from this source, not an actual increase in emissions (Monterey Bay Unified Air Pollution Control District, 1975). These emissions, due to steam injection procedures at the San Ardo oil fields, are being eliminated by new control procedures. The recent recognition of this hydrocarbon source and the anticipated effectiveness of available control techniques were major factors in the decision by ARB not to recommend the AQMA designation for Monterey County at this time.

In summary, depending on the prevalent weather conditions of any given year, the study area experiences minor to moderate air quality problems. The quality is significantly better than the major urban areas of California (Los Angeles basin and San Francisco Bay area), but worse than that of the more rural counties in the state.

Table 3

DAYS EXCEEDING FEDERAL AND STATE 1-HOUR OXIDANT STANDARDS*

Station	Year	Days of Data	Days Exceeding National Primary Standard	Days Exceeding California Standard
Carmel	1973	85	5	0
	1974	264	1	1
Gonzales	1970	248	2	0
	1971	353	6	2
	1972	337	5	3
	1973	331	6	5
	1974	359	1	0
Hollister	1973	244	16	2
	1974	143	4	1
Monterey	1970	260	0	0
	1971	249	1	1
	1972	240	1	0
	1973	351	7	4
	1974	351	1	1
Salinas	1970	343	1	0
	1971	354	0	0
	1972	358	0	0
	1973	356	6	3
	1974	350	2	0
Santa Cruz	1970	364	0	0
	1971	353	2	1
	1972	364	0	0
	1973	363	2	0
	1974	360	1	0
Watsonville	1972	178	6	0
	1973	91	0	0

* Corrected from data originally recorded on instruments calibrated with neutral buffered potassium iodide reagents. Equivalent to data from instruments calibrated by ultraviolet photometry (see (Appendix A-2).

Source: California Air Resources Board, 1970-1975.

Table 4

PARTICULATE 24-HOUR AVERAGES EXCEEDING STATE AND FEDERAL AMBIENT AIR QUALITY STANDARDS

	Percent of Values 100 $\mu g/m^3$ or More (State Standard)					
	1970	1971	1972	1973	1974	5-Year Average
Hollister	--	--	--	--	0	--
Gonzales	27	25	18	19	0	18
Salinas	26	25	23	35	28	27
Salinas #2*	--	--	--	--	0	--
Monterey	0	0	0	0	0	0
Santa Cruz	5	0	0	10	10	5
Watsonville	--	--	0	21	7	9

	Percent of Values Exceeding 150 $\mu g/m^3$ (Federal Secondary Standard)					
	1970	1971	1972	1973	1974	5-Year Average
Hollister	--	--	--	--	0	--
Gonzales	0	8	4	3	0	3
Salinas	0	5	5	22	2	7
Salinas #2*	--	--	--	--	0	--
Monterey	0	0	0	0	0	0
Santa Cruz	0	0	0	0	0	0
Watsonville	--	--	0	3	0	1

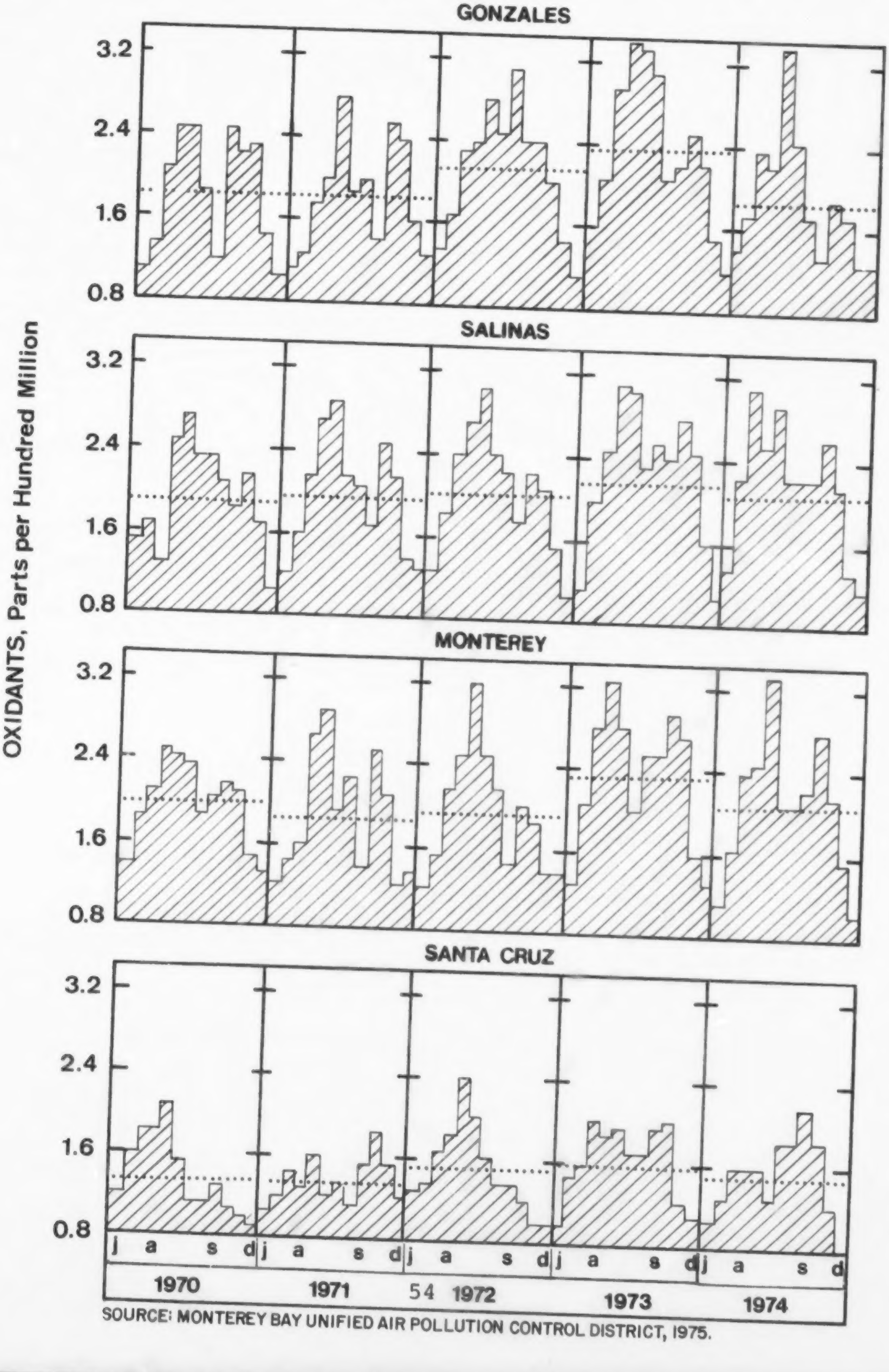
* Salinas #2 - 1270 Natividad Road, Salinas is site of District Office and Monitoring Station in late 1975. Data through July 1974 not reported because high numbers reflected dirty conditions from local highway and building construction.

Source: Monterey Bay Unified Air Pollution Control District, 1975.

OXIDANT Monthly and Annual Average

Figure 13

(Note: Data corrected for recent change in instrument calibration procedures, see Appendix A2 — air quality standards apply to single hour events, not monthly or annual averages)



SOURCE: MONTEREY BAY UNIFIED AIR POLLUTION CONTROL DISTRICT, 1975.

Water Resources

Introduction. The study area's water courses and bodies of water are many and have complex interrelationships. Water information, to be useful to specialists, must be given in a technical vocabulary. A simple digest of the study area's major water features, and a glossary that includes the technical terminology (in the back of the report) therefore seems in order.

There are large seasonal fluctuations in local water flows. Heavy rainfall in the winter increases water quantity, and, generally speaking, improves water quality as pollutants are less concentrated in the larger volumes of runoff. Seasonal fluctuation is especially marked in the Salinas River, for by far the greater part of its flow is subterranean (i.e., flowing underground). During the rainy season inflows to the channel are sufficient to provide considerable surface flow. Some of the subterranean water is drawn up for irrigation and domestic use, but most water flows underground into Monterey Bay.

Domestic waste disposal and agricultural runoff (from irrigation) are the two chief offenders in lowering surface water quality, making study area waters unsuitable in varying degrees for various uses, as is set forth in the following pages.

The three principal groundwater aquifers in the Salinas Valley also fluctuate with the seasons. Heavy agricultural and domestic use of the underground supplies accentuate the fluctuation in the summer months. Groundwater drawdown has become so severe in the lower Salinas Valley that seawater is intruding inland, increasing the *salinity* of groundwater in some areas to the point that it is not fit for domestic or agricultural use.

Surface Water -- Quantity and Quality. The principal surface waters of the study area are the lower Salinas River and its tributaries; Elkhorn, Tembladero, and Moro Cojo Sloughs; Old Salinas River; the Blanco Drain, and the Main Reclamation Ditch (see Figure 14). The U. S. Geological Survey, the California Department of Water Resources and the Monterey County Flood Control and Water Conservation District are the principal sources of water quality and quantity data in the area. The Flood Control District operates Nacimiento and San Antonio Reservoirs, the two principal Salinas River water sources.

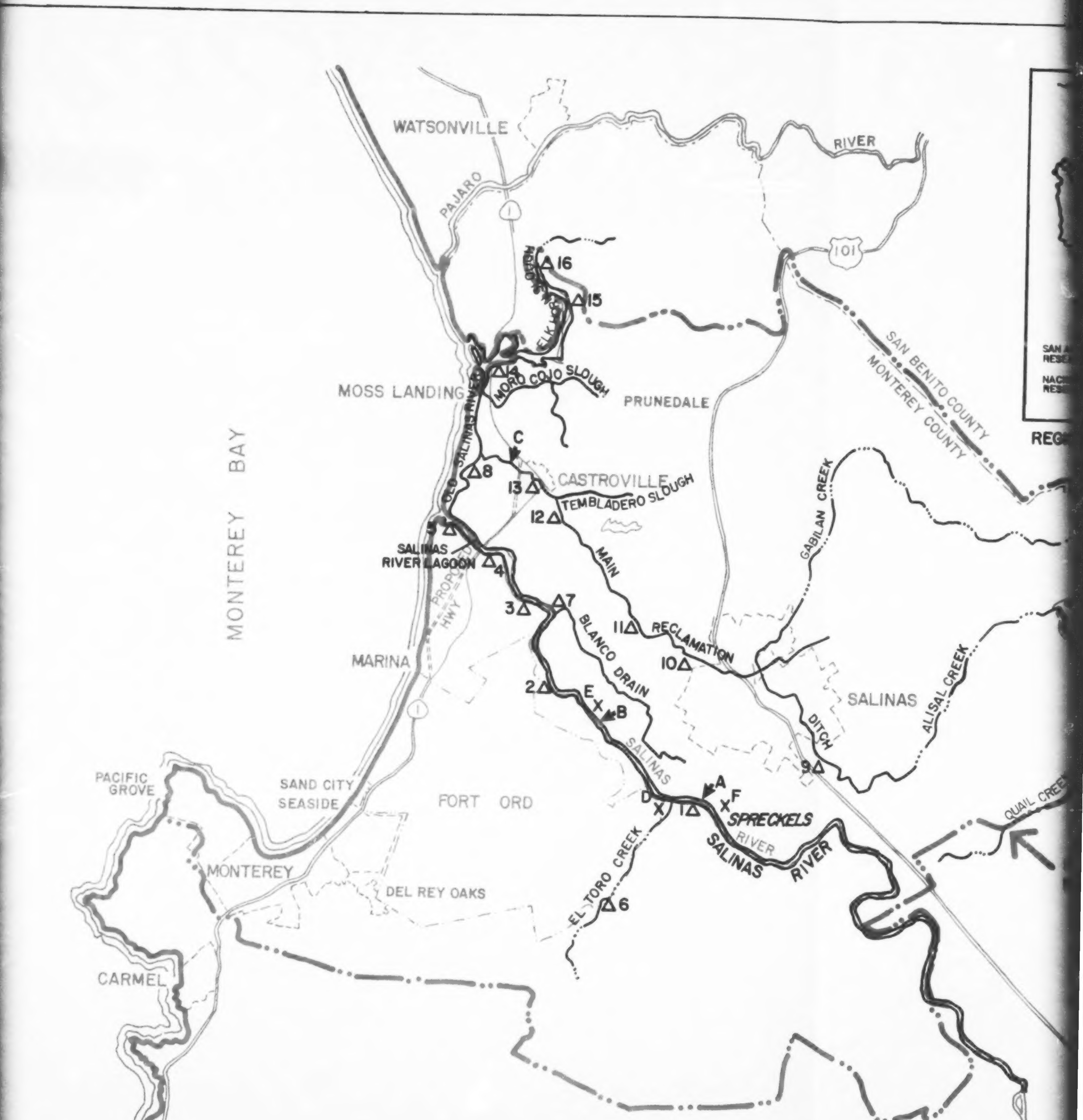
Water quality standards observed in this report are those of the State Water Resources Control Board, the Central Coastal Regional Water Quality Control Board and the Environmental Protection Agency.

Lower Salinas River. The Salinas River is the major surface stream in the study area and is one of the largest streams on the central California coast. The extreme seasonal fluctuations in its surface flow and the large inputs of domestic wastewater and agricultural runoff that reach its lower stretches have combined to create adverse water quality conditions. The relative influence of these several factors affecting water quality is not known; resolution of their influence would require considerable monitoring of hydrologic and chemical conditions in the river below Salinas. High bacterial counts and pesticide levels, and nuisance *algal blooms* are the major water quality problems, especially during the summer months. These conditions limit the recreational use of the stream due to potential health hazards. They also limit the abundance and variety of fish life in the stream and its lagoon.

Variations in flow in the Salinas River just below Spreckels (Table 5 and Figure 15) reflect changed conditions since construction of the Nacimiento Reservoir in 1957 and the San Antonio Reservoir in 1965. The dams reduce normal spring runoff and, during the summer, their releases are percolated to the groundwater or diverted for municipal and agricultural use before reaching Spreckels, eliminating most flow in the lower river (U. S. Geological Survey, 1973). In wet years, some reservoir releases are allowed to flow beyond normal recharge areas in summer and fall (Taylor, pers. comm.), but their relative contribution to late summer flows at Spreckels is not known. Surface flows in the river were being modified significantly by agricultural diversions prior to construction of the reservoirs, but the dams have increased the degree of regulation.

During July and August, surface runoff at the USGS Spreckels gauging station is about 1.5 cubic feet per second (*cfs*; equivalent to one million gallons per day [mgd]) and is primarily wastewater from the Salinas-Alisal sewage plant discharge just upstream. Below Spreckels the main Salinas wastewater treatment plant discharges 5-6 mgd (7.8-9.3 cfs) of effluent into the river channel, significantly augmenting summer flows. Flows decrease below this point until water from the Blanco Drain is pumped into the river bed about 5 miles below the main treatment plant discharge. Summer flows from the Blanco Drain averaged from 3-6 cfs (roughly 2-4 mgd) in 1965 (California Department of Water Resources, 1965). More recent flow data indicate the flow averaged 3.2 cfs (2.1 mgd) in the 6-month period between May 1 and November 1, in the years 1972 to 1974 (modified from data supplied by Binder, pers. comm.).

The beneficial uses assigned to the lower Salinas River (Table N-2) by the RWQCB include fish migration, warmwater fish habitat, wildlife habitat, and non-contact recreation. The recommended water quality standards (Table N-3) for protecting


WATSONVILLE
PAJARO
RIVER
1
101
16
15
ELKHORN SLOUGH
14
MOSS LANDING
MORO COJO SLOUGH
PRUNEDALE
SAN BENITO COUNTY
MONTEREY COUNTY
MONTEREY BAY
C
8
OLD SALINAS RIVER
13
CASTROVILLE
TEMBLADERO SLOUGH
12
5
SALINAS RIVER LAGOON
PROPOSED HWY
4
MAIN
GABILAN CREEK
3
7
11
RECLAMATION
BLANCO DRAIN
MARINA
10
ALISAL CREEK
2
E
B
SALINAS
DITCH
9
SALINAS
PACIFIC GROVE
SAND CITY
SEASIDE
FORT ORD
D
1
A
F
SPRECKELS
QUAIL CREEK
RIVER
SALINAS RIVER
MONTEREY
EL TORO CREEK
DEL REY OAKS
6
CARMEL

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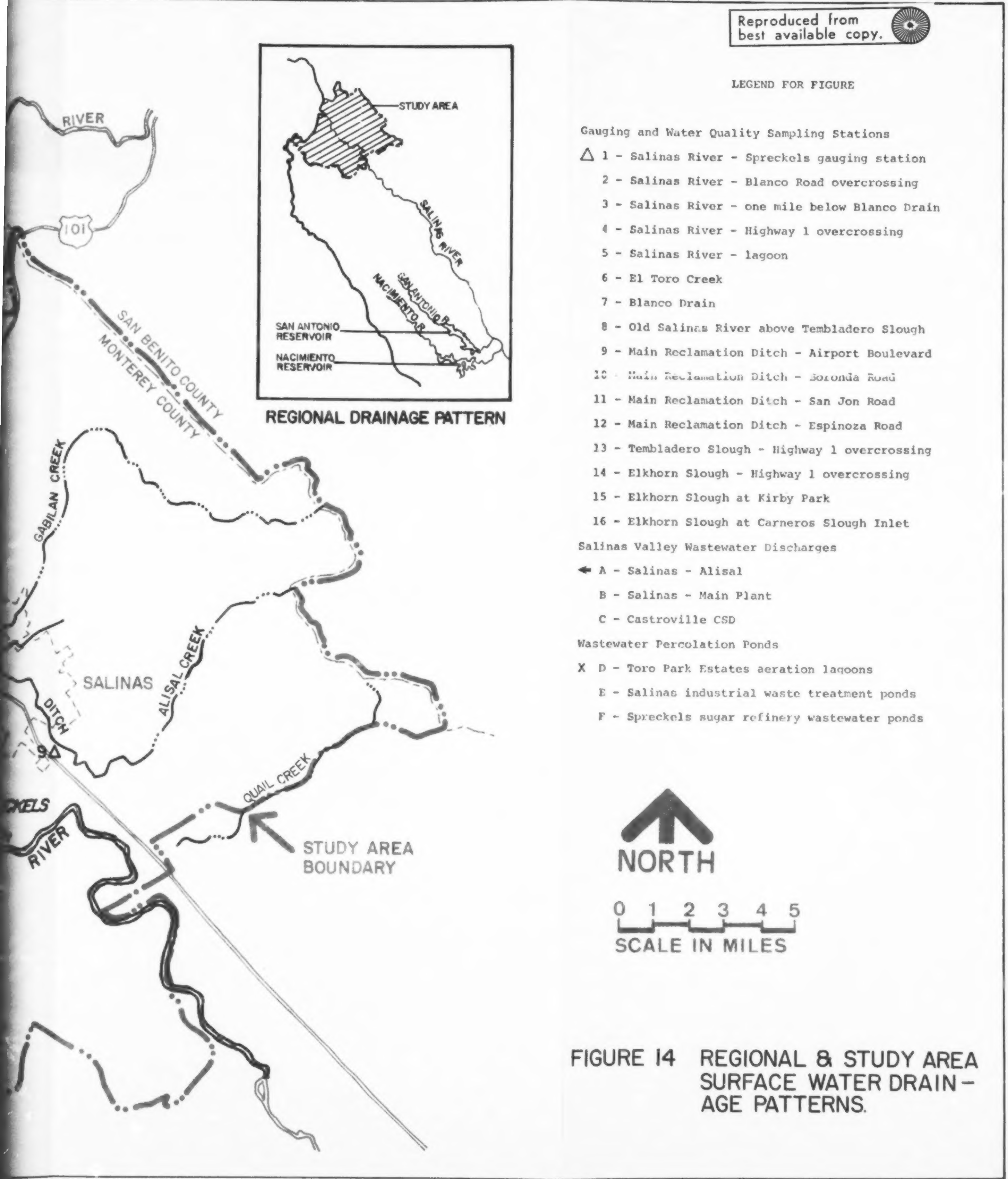


REGIONAL DRAINAGE PATTERN

LEGEND FOR FIGURE

Gauging and Water Quality Sampling Stations

△ 1 - Salinas River - Spreckels gauging station
2 - Salinas River - Blanco Road overcrossing
3 - Salinas River - one mile below Blanco Drain
4 - Salinas River - Highway 1 overcrossing
5 - Salinas River - lagoon
6 - El Toro Creek
7 - Blanco Drain
8 - Old Salinas River above Tembladero Slough
9 - Main Reclamation Ditch - Airport Boulevard
10 - Main Reclamation Ditch - Boronda Road
11 - Main Reclamation Ditch - San Jon Road
12 - Main Reclamation Ditch - Espinoza Road
13 - Tembladero Slough - Highway 1 overcrossing
14 - Elkhorn Slough - Highway 1 overcrossing
15 - Elkhorn Slough at Kirby Park
16 - Elkhorn Slough at Carneros Slough Inlet

Salinas Valley Wastewater Discharges

◄ A - Salinas - Alisal
B - Salinas - Main Plant
C - Castroville CSD

Wastewater Percolation Ponds

X D - Toro Park Estates aeration lagoons
E - Salinas industrial waste treatment ponds
F - Spreckels sugar refinery wastewater ponds

FIGURE 14 REGIONAL & STUDY AREA SURFACE WATER DRAINAGE PATTERNS.

Table 5*

MONTHLY VARIATION OF SURFACE RUNOFF IN SALINAS RIVER

Type of Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Dry (1960-61)													
(cfs)[2]	1.1	2.9	3	1.3	1.1	1.0	.8	1.3	1.2	1.0	0.8	0.8	1.3
in acre-feet	68	178	184	80	61	62	48	80	71	62	49	48	990
Wet (1940-41)													
(cfs)	8.0	12	870	2,886	9,324	8,334	7,191	945	227	44.6	7.2	4.6	2,443
in acre-feet	492	714	53,430	177,200	517,100	514,800	427,300	58,000	13,480	2,740	444	273	1,766,000
Median (1930-57)[3]													
(cfs)	3	7.5	12.0	88.9	393	415	71.4	8.6	2.0	1.3	1	1.4	82
in acre-feet	183	446	738	5,460	21,800	25,500	4,240	526	119	61	61	83	59,220[5]
% of annual runoff	0.3	0.8	1.2	9.2	36.8	43.1	7.2	0.9	0.2	0.1	0.1	0.1	100
Median (1957-70)[4]													
(cfs)	4.5	4.7	17.6	103	361	289	12.7	11.2	3.9	1.5	1.6	3	66
in acre-feet	275	282	1,080	6,330	20,020	17,770	756	689	234	95	96	178	47,800[5]
% of annual runoff	0.6	0.6	2.2	13.2	41.9	37.2	1.6	1.4	0.5	0.2	0.2	0.4	100

---

[1] Salinas River below Spreckels. Drainage area - 4,156 square miles. Period of Record - October 1929 to present.

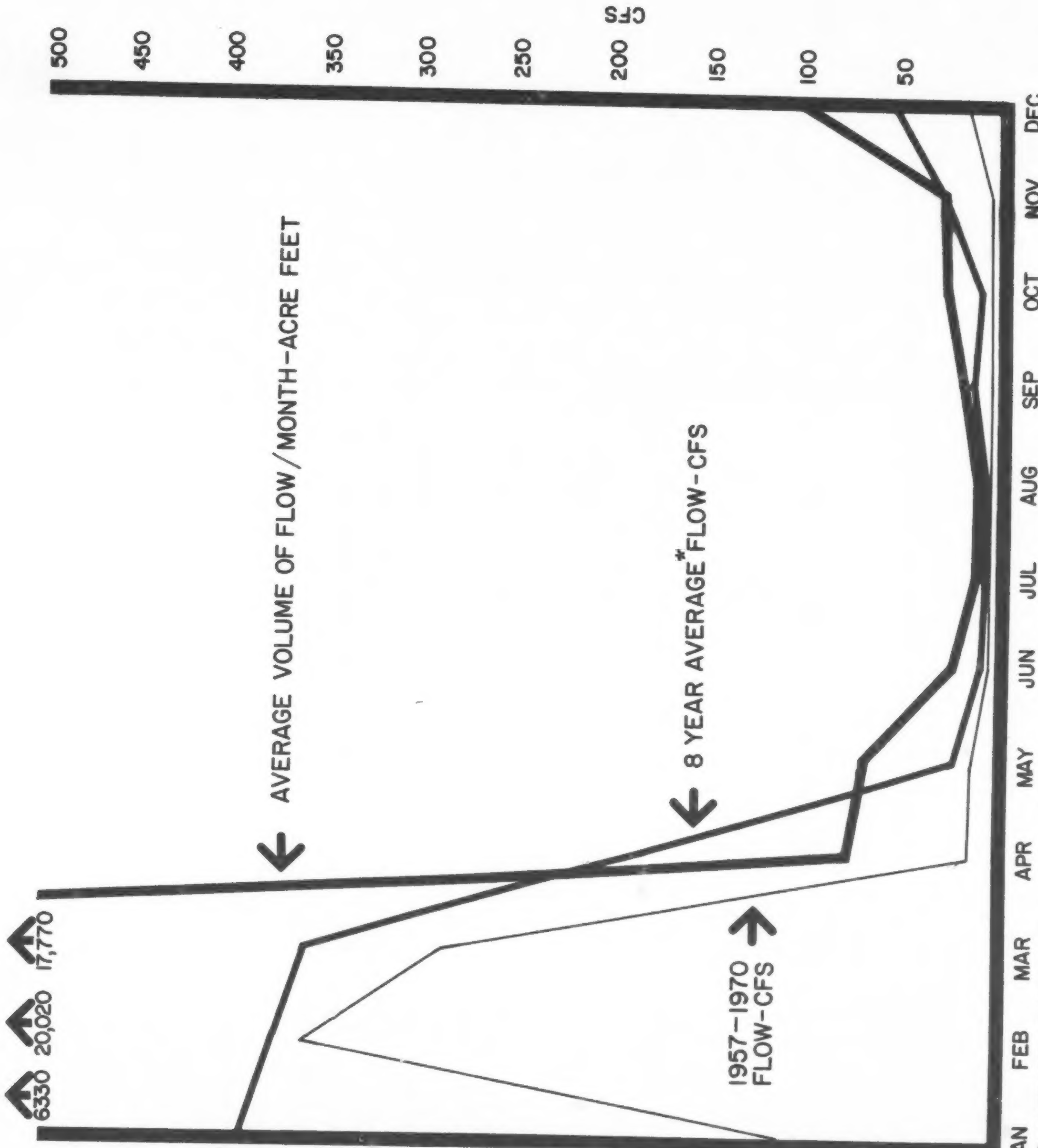
[2] Cfs calculated by Jones & Stokes Associates, Inc., assuming a uniform flow throughout each month.

[3] Median discharge from 1930 to 1957 (27 years). Nacimiento Reservoir regulation began in November 1956.

[4] Median discharge from 1957 to 1970 (13 years).

[5] Sum of monthly medians.

* Source: Yoder-Trotter-Orlob & Associates, 1973.



* AVERAGE OF WATER YEARS 64-65 TO 73-74 MINUS TWO HIGHEST RECORDINGS

FIGURE 15 SALINAS RIVER FLOWS RECORDED AT SPRECKELS GAGING STATION

SOURCES: YODER, TROTTER, ORLOB & ASSOCIATES, 1973; US GEOLOGICAL SURVEY, WATER RESOURCES DATA FOR CALIF., 1966-1975 these uses are frequently not met, especially during low flow periods. Ammonia, total phosphate, and *dissolved oxygen* levels in the lower river often do not meet standards. Electrical conductance and *pH* standards are also exceeded in the Salinas River lagoon at various times of the year.

From the City of Salinas to the ocean, river water quality is influenced by extreme seasonal fluctuations in surface flow, discharge of secondarily treated wastewater from Salinas, and agricultural return flows. From December through March, when 94 percent of the annual runoff occurs, water quality usually meets RWCQB standards for beneficial uses along the entire stretch of the river.

In low flow periods (usually April through November) the river below the Salinas-Alisal treatment plant outfall is mostly secondary treated sewage effluent. Dissolved oxygen levels are low (frequently less than 4 *mg/l*), the river bottom is coated in some locations with sludge, and there is often a strong hydrogen sulfide odor. Total *dissolved solids (TDS)* levels often exceed 900 *ppm* (compared to 225-650 *ppm* in high flows), reflecting the input of treatment plant effluent and agricultural runoff and the low level of dilution from surface flows. Bacterial counts exceed the public health limits for recreational use of the waterway. Table 6 presents quality fluctuations recorded in 1964 and 1965 by the California Department of Water Resources. These data, although slightly dated, give the best available picture of quality fuctuations along the lower river during both low and high flow conditions (more recent, but less complete data are provided in Table E-1).

The California State Bureau of Sanitary Engineers indicated there is a gradual increase in coliform bacteria contamination of the river below Salinas (California State Department of Public Health, 1971). Coliform counts in excess of 24,000 *MPN/* 100 ml were recorded near Blanco Road during low flow conditions in May 1971, and more recently in October of 1975 (Baldridge, pers. comm.). Similar high coliform counts have been recorded on other stretches of the lower Salinas River.

Mineral levels also gradually increase downstream until Blanco Drain irrigation return water enters the river causing a large jump in TDS and nutrient levels.

Pesticide residues are found in high concentrations throughout the lower Salinas River. Table E-2 presents data collected from several locations along the river in the 1971-1972 water year; all stations recorded pesticide levels in excess of EPA and RWQCB recommended standards for freshwater aquatic use. Dieldrin content exceeded the recommended standards by 10 parts per trillion (*ppt*) during high flows below Blanco Drain and by 1,550 ppt during low flow at the State Highway 1

Table 6

SALINAS RIVER WATER QUALITY, 1964-65

Parameter	Highway 68		One Mile Below Blanco Drain		Highway 1		Lower Lagoon	
	Low Flow[1]	High Flow[2]	Low Flow[1]	High Flow[2]	Low Flow[1]	High Flow[2]	Low Flow[1]	High Flow[2]
Temperature, °F	66-69	50-63	66-69	50-63	66-70	50-63	66-70	50-63
pH	7.3-7.5	--	8.2-9.1	7.5-7.7	9.0-9.6	7.5-8.7	9.0-9.6	7.8-8.7
Dissolved oxygen, ppm	<4	5.9-9.5	16-23	9-13	9-32	7-28	3-32	8-28
Specific conductance, micromhos/cm^3	1,426	377-1,081	2,059	377-8,500	1,900->10,000[3]	397->10,000	—	—
BOD, ppm	2.8	3.7	14	4.7	24	—	16	—
DDT, ppt	—	—	60	10	—	—	40	—

[1] Measurements made during August, September and October of 1964; flows measured at Highway 68 bridge ranged from 0.7-4.0 cfs.

[2] Measurements made during January, February and March of 1965; flows measured at Highway 68 bridge ranged from 8-1,490 cfs.

[3] Measurement period from September to December, 1964.

Source: California Department of Water Resources, 1965; sampling locations are shown on Figure 12.

bridge. A similar pattern of high levels was recorded for parathion. Concentrations of pesticides are highest during the summer when agricultural return flows are at a peak and normal stream runoff is low. It appears that recommended levels are exceeded for some compounds on a year-round basis, however. Only a few of the compounds identified in the sampling are presented in the table, but they reflect the high concentrations and the seasonal fluctuations in pesticides.

Approximately 1.5 miles before entering the bay the Salinas becomes a tidal lagoon (Figure 16), the flow traveling directly west through lagoon and sand dunes to the ocean. A sandbar builds up across the mouth of the lagoon in June or July and usually remains throughout the summer, reducing tidal influence and lowering water quality by retaining upstream wastewater discharges and agricultural runoff. There are nearly constant algal blooms, and large *diurnal* fluctuations in dissolved oxygen. During low flows, the bacterial contamination is also high. Samples collected in May 1971 at the Highway 1 bridge contained 1,950 MPN/100 ml median total coliform and 230 MPN/100 ml median fecal coliform. Flows during this sampling period were estimated to be 7.3 cfs (4.7 mgd) at the Spreckels gauging station (California Department of Public Health, 1971). In the fall, the Monterey County Flood Control and Water Conservation District (MCFCWD) often bulldozes the river mouth open, to minimize flooding and improve local drainage along the lagoon.

Tidal influxes through the Salinas River lagoon occasionally reach more than one mile upstream, significantly raising the river TDS level. The 1964-65 Department of Water Resources study of the lower river recorded a specific conductance of 8,500 *micromhos* (roughly 5,950 TDS) nearly two miles upstream from the Highway 1 bridge.

Salinas River Tributaries. The main study area streams tributary to the Salinas River are Gabilan, Alisal, Quail, and El Toro Creeks. Gabilan and Alisal actually empty into the Main Reclamation Ditch near Salinas. These streams carry small flows in the wet months, January to April or May. El Toro Creek drains the Sierra de Salinas Mountains between Salinas and Monterey on the west side of the valley (Figure 12). Quality data for these streams have not been included, as little is available. Quality data for the Main Reclamation Ditch and the Salinas River reflect the input of these small tributary streams.

Blanco Drain. Blanco Drain carries the irrigation return water of 6,000 agricultural acres southwest of Salinas into the Salinas River 4 miles upstream from the State Highway 1 bridge (and 4-1/2 miles downstream from the main Salinas wastewater treatment plant discharge). Volume of flow is highly seasonal and has not been regularly measured, but the MCFCWD recently

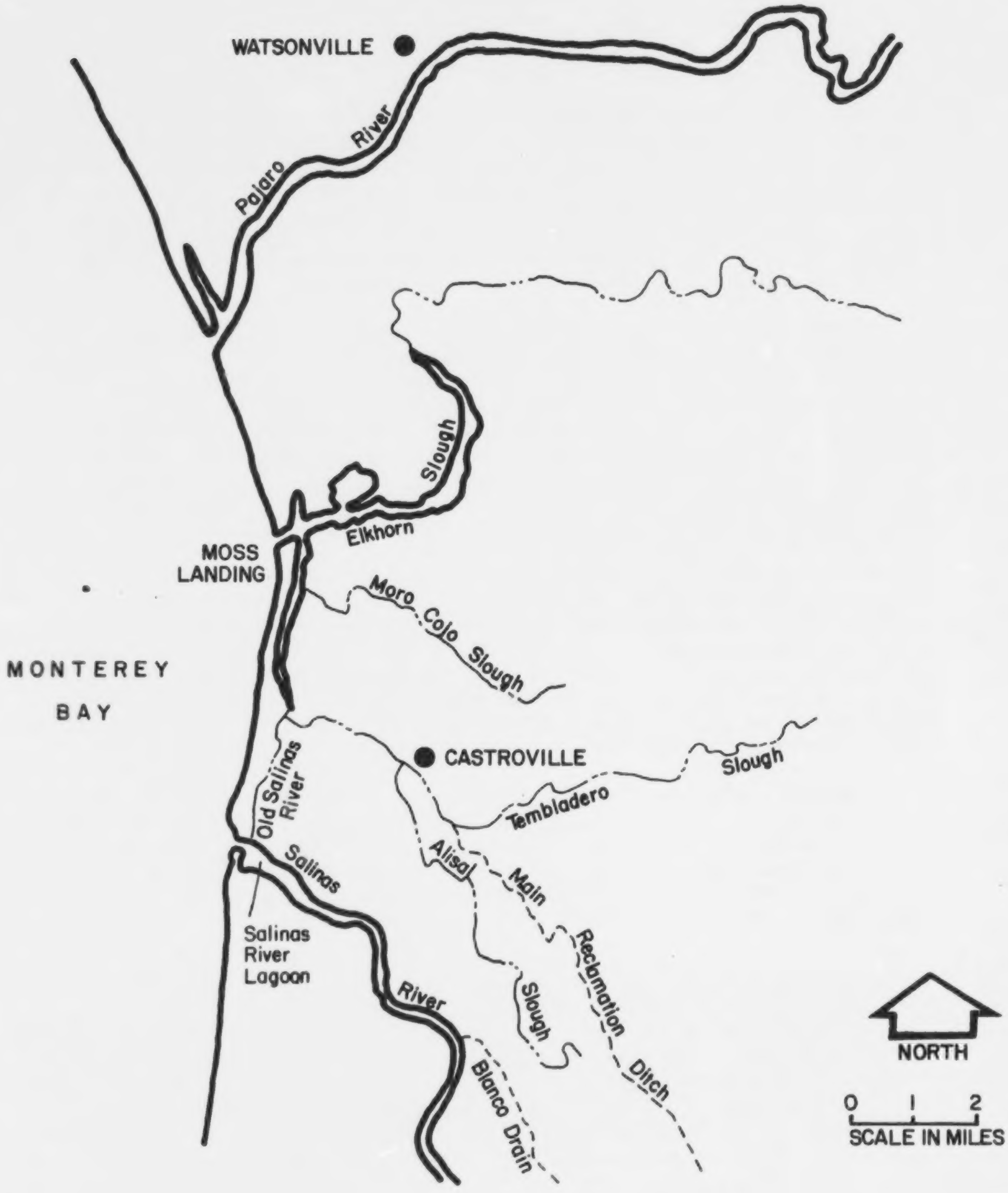


FIGURE 16 SURFACE WATERS OF THE LOWER SALINAS VALLEY
(MODIFIED FROM: WATER RESOURCES ENGINEERS, INC. 1969)

began a flow monitoring program. There are generally two annual peaks in flow, one during crop irrigation in the summer months and one in the winter from storm runoff. Some estimates of Blanco Drain flows were presented in the Salinas River section above.

Highly mineralized inflow from a perched water table and pesticides and nutrients in irrigation runoff contributed to the poor water quality of the drain. Agricultural runoff may at times improve the mineral quality in the drain by diluting the high TDS groundwater inflows (from the surface aquifer). However, during the rainy season when irrigation return flows are low, groundwater may rise to the point that it surfaces in the drain, creating extremely high TDS conditions.

TDS levels in Blanco Drain near its discharge to the Salinas range from 3,900 to 4,300 mg/l (U. S. Bureau of Reclamation, 1971). This exceeds the RWQCB recommended limit of 1,500 mg/l for freshwater aquatic life and fish migration (designated beneficial uses of the Salinas below the Blanco Drain discharge). Total nitrogen and *phosphorous* frequently exceed standards for maintaining the river's warm water fishery (California Regional Water Quality Control Board, Central Coast Region, 1974a). The recommended standards are 2.0 and 0.2 mg/l respectively for nitrogen and phosphorous. Total nitrogen levels frequently exceed 10 mg/l and total phosphorous has been recorded recently at 1.0 mg/l (Taylor, pers. comm.). This excess of nutrients contributes to large algal blooms and, consequently, low dissolved oxygen levels in the Salinas River during the summer. The Monterey County Flood Control and Water Conservation District is now monitoring the quality of Blanco Drain water on a regular basis as requested by the RWQCB. This is seen as a first step toward solving any water quality problems created by the agricultural return flows.

Though *herbicide* and pesticide analyses in Blanco Drain have been infrequent, in May 1971 the California Department of Public Health (1971) recorded 200 parts per trillion (ppt) parathion in the drain one half mile above its discharge to the Salinas River. The maximum level recommended for streams supporting freshwater aquatic life is 1 ppt.

Main Reclamation Ditch. The Main Reclamation Ditch carries runoff from Gabilan and Alisal Creeks, a large agricultural area between Salinas and the coast, and several industrial discharges. It empties into Tembladero Slough near Castroville. There is water in the ditch year round, with peak flows from December to March (storm runoff) and again during July and August (agricultural return water).

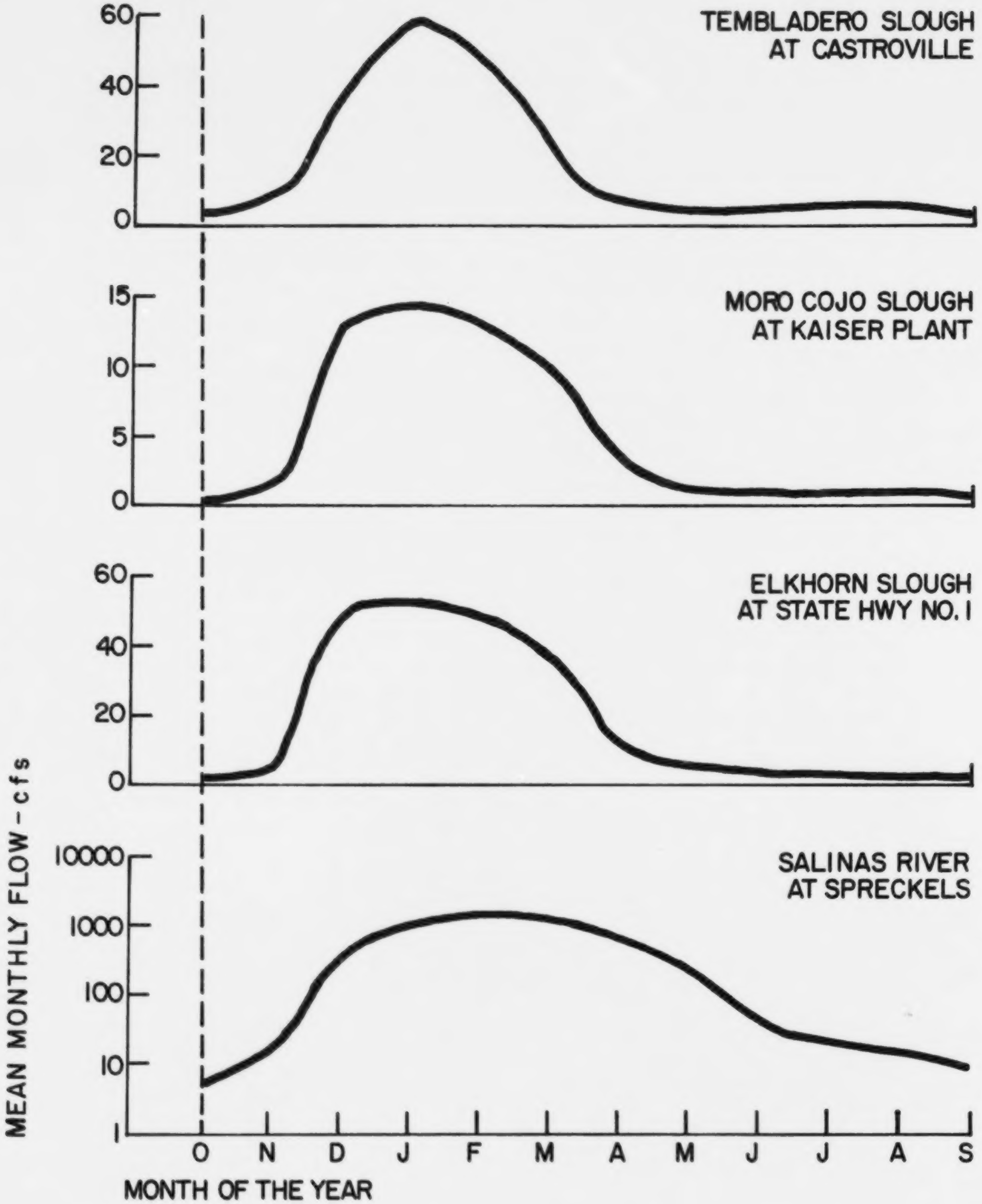
Maximum recorded discharge at San Jon Road (2-1/2 miles west of Salinas) was 401 cfs in February 1973, and the minimum was 0.34 cfs in January 1972 (U.S. Geological Survey, 1973). Mean monthly discharges range from 4-55 cfs at this location (Monterey County Flood Control and Water Conservation District, n.d.). Flows are not recorded at the junction of the Main Reclamation Ditch and Tembladero Slough.

Water quality in the Main Reclamation Ditch is checked regularly at its junction with San Jon Road just west of Salinas (Table E-4). When industrial food processing plants are operating in Salinas, there is a peak in TDS and *chloride* concentration, reduced somewhat downstream by the inflow of agricultural return water. Phosphates and nitrates have been measured in high concentrations. As the table shows, pesticide levels measured in 1971 exceeded EPA and RWQCB standards for freshwater aquatic habitat and the RWQCB's standards for saltwater habitat. Pollutants carried in the Main Reclamation Ditch are discharged to the Old Salinas River via Tembladero Slough. This water eventually flows into Moss Landing Harbor and Elkhorn Slough, which supports an exceptional population of estuarine flora and fauna.

Elkhorn, Tembladero and Moro Cojo Sloughs. Elkhorn, Tembladero and Moro Cojo Sloughs drain agricultural land and rolling hills near Castroville. *Hydrographs* of the average annual flow in these three sloughs were estimated by Water Resources Engineers in 1969 (see Figure 17).

Tembladero Slough receives agricultural water and storm runoff from the Merritt Lake area, the Main Reclamation Ditch, farmlands south of Castroville, and about 0.3 mgd of treated Castroville wastewater (wastewater is not included in the hydrograph). The slough flows into the Old Salinas River channel west of Castroville and upstream from a tide gate which reduces salt water influence in the Old River channel. These waters eventually flow into Moss Landing Harbor and Monterey Bay.

Samples analyzed by the State Department of Water Resources and Department of Public Health over the last 30 years indicate TDS ranges from 680-1,770 ppm at the Highway 1 overcrossing of Tembladero Slough. Chlorides range from 94-354 ppm, nitrates from 20.4-36.2 ppm and total coliforms from 620-2,300 MPN/100 ml (U.S. Bureau of Reclamation, 1974). Downstream below the Castroville treatment plant, TDS and bacteria counts are much higher. The high TDS levels are due in large part to tidal influences through Moss Landing Harbor and Old Salinas River, and are therefore a natural condition that has existed for many years. Installation of the tide gate on the Old River has undoubtedly reduced TDS levels from previous years, however. Total coliform counts as high as 24,000 MPN/100 ml have been recorded at the mouth of Tembladero Slough.



AVERAGE ANNUAL HYDROGRAPHS FIGURE 17

SOURCE: WATER RESOURCE ENGINEERS, 1969

Moro Cojo Slough is directly connected to Moss Landing Harbor. Historically it was subject to tidal influence; however, construction of a tide gate at the State Highway 1 overcrossing in 1932 turned the slough into a brackish water area with little or no ocean influence (Gordon, 1974). Agricultural runoff and evaporation have acted to maintain extremely high TDS levels in the slough during the summer months. Soil Control Labs of Watsonville recently analyzed the slough's water quality for the Central Coast Regional Coastal Zone Conservation Commission. Their findings are presented in Table 7.

Elkhorn Slough is directly connected to the ocean through Moss Landing Harbor and is therefore under tidal influence. Daily tide cycles and annual changes in freshwater inflow constantly alter salinity. A tide gate at the Elkhorn Road crossing limits the inland influence of the salt water. Runoff from the low rolling hills east and northeast of the slough and scouring by the tides are sufficient to keep the mouth of the slough open to the ocean year-round.

Because of its closeness to commerce and industry, and its value as a wildlife habitat, Elkhorn Slough's water quality is well documented. Bacterial counts in the slough have increased steadily since the late 1950's. The County Health Department measured total coliform levels as high as 24,000 MPN/100 ml in 1970 (Browning, et.al., 1972). Waste discharges from commercial and recreational boats in Moss Landing Harbor, runoff from dairies on the south bank of the slough, and treatment plant effluent carried in from Tembladero Slough and Old Salinas River all contribute to the high counts. A detailed bacterial analysis of the slough conducted by Water Resources Engineers (1969) in 1968 indicated highest fecal coliform counts occur during flood tides when materials are carried up the slough from the harbor. Samples taken from nine stations in the slough from Highway 1 to a point 3-1/2 miles inland contained median fecal coliform counts of approximately 40 to 75 MPN/100 ml and maximum counts of 50 to 2,000 MPN/100 ml (Water Resources Engineers, 1969). The high readings exceed recommended levels for shellfish harvesting (70) and water contact recreation (200), both of which are beneficial uses assigned to Elkhorn Slough by the RWQCB.

Nitrogen and phosphorous measurements made by the Northern Salinas Valley Mosquito Abatement District in the summer of 1975 do not indicate a high nutrient problem in Elkhorn Slough. Other indicators -- dissolved oxygen levels, pH and turbidity -- also do not indicate a serious *algae* problem, even though it might be expected to occur due to the influx of wastewater into the slough (see Table E-3).

Table 7

MORO COJO SLOUGH WATER QUALITY*

Constituent (mg/l)	Sample Location** M1	 M2	 M3
pH (pH units)	9.36	8.55	8.20
BOD	0	96	18
Dissolved oxygen	9.8	14.7	8.4
Salinity	36,230	45,680	47,180
Pesticides-DDE	<.0001	.0002	.001
Sodium	10,400	12,500	15,000
Chloride	20,600	26,000	26,800
Cadmium	.003	.002	.002
Total chromium	<.005	<.005	<.005
Nitrate-N	<.1	.52	.17
Nitrite-N	<.01	<.01	<.01
Organic nitrogen	3.10	1.20	4.60
Total phosphorus	1.50	6.60	.1
Phosphate-P	1.03	3.20	.06

* Source: Soil Control Labs (pers. comm.)

** Station M1 located immediately south of Kaiser tailings pond; M2 located on western arm of slough approximately 3,000 feet above junction of the two arms; M3 located on eastern arm of slough approximately 4,000 feet above junction of the two arms.

Old Salinas River. Between 1908 and 1910 the Salinas River cut through to the coast at its present location; this left the old main channel, which empties into the ocean north of Moss Landing, as an intermittent arm (Gordon, 1974). Since then, the junction of the old and new channels has been diked and a tide gate installed to reduce flows through the old channel. A culvert at the junction allows a maximum of 100 cfs to enter the old channel from the new when the gates are open. In the summer months the culvert carries an average of 30 cfs (Water Resources Engineers, 1969). In the fall the tide gate is closed, eliminating wet season flow from the new channel into the old. Before entering Moss Landing Harbor, the Old Salinas River receives runoff from Tembladero Slough. The old channel is also blocked by a tide gate at its entrance to Moss Landing Harbor. Surface flows are therefore influenced by an assortment of variables, including flows in the main Salinas River and Tembladero Slough, and the tide gates.

During the summer, irrigation return water is the principle contributor to the Old River's flow and to its contamination, with high TDS levels and an abundance of nutrients. In the wet season, quality improves.

Marine water influxes through Moss Landing Harbor, in conjunction with agricultural return flows, create high salinity in the Old River. TDS levels from 1,400 to 2,400 ppm were recorded above Tembladero Slough in 1972 (California Department of Water Resources, 1974). Bacteriological contaminants are high. In 1967 the California Bureau of Sanitary Engineering measured total coliform bacteria of >24,000 MPN/100 ml. Coliform sources are not all fecal; agricultural drainage also contributes, but the Castroville sewage discharge is thought to be adding significantly to the bacterial count in the Old River and Moss Landing Harbor (Water Resources Engineers, 1969).

The coliform concentration in Old Salinas River also fluctuates with the tide. Water Resources Engineers (1969) measured the highest fecal coliform count during flood tide (approximately 10,000 MPN/100 ml) and the lowest during slack tide (approximately 600 MPN/100 ml). This indicates that some of the bacterial contamination is carried in from Moss Landing Harbor. Additional water quality data for the Old Salinas River are presented in Table E-5.

Groundwater Quantity and Quality. There are several distinct aquifers within the study area; the major ones are associated with the Salinas River groundwater basin. The three most prominent are the 180-foot and 400-foot pressure aquifers and the East Side aquifer (see Figure 18). The 180-foot and 400-foot are called pressure aquifers because they are overlain by impermeable material, restricting exchange of water between aquifers. The East Side aquifer is an unconfined aquifer; that is, if enough groundwater were present it could rise to ground surface. There is a fourth less extensive aquifer that exists in the lower Salinas Valley above the 180- and 400-foot aquifers. It is *perched* above these deeper aquifers by an impermeable clay layer and is subject to extreme depth and quality fluctuations.

Two aquifers supplied by precipitation on the sand dune terrain of Ft. Ord and vicinity exist along the coast from Marina to Seaside. The minor surface aquifer is little used and is subject to occasional seawater intrusion if pumped heavily. The main aquifer supplies a major portion of domestic water for Seaside, Ft. Ord and Marina.

The 180-foot, 400-foot and East Side aquifers are the principal sources of water in the lower Salinas Valley. They are recharged by natural rainfall and overland flow and manipulated releases from Nacimiento and San Antonio Dams on the upper Salinas River watershed. The estimated annual safe yield of the combined 180- and 400-foot aquifers is 78,000 acre-feet and for the East Side aquifer it is 19,000 acre-feet (Yoder-Trotter-Orlob & Associates, 1973). The surface aquifer is seldom used as a source of water due to its poor quality.

In all three aquifers, there are zones that have much higher TDS concentrations than other parts of the basin. These are mapped in Figure 18. The zone in the 180-foot and East Side aquifers near Salinas is generally believed to be caused by the percolation of agricultural return water through discontinuities in the impermeable layer that overlies the 180-foot aquifer (California Department of Water Resources, 1973a). While the area of the high TDS problem is increasing, the concentration of salt is not. TDS levels in excess of 1,500 mg/l are common in this area. The high salt content is making the groundwater unfit for domestic and agricultural use.

Since 1940 there has been noticeable seawater intrusion into the 180-foot aquifer near the coast. Similar intrusion has occurred in the 400-foot aquifer since 1959. This indicates that there is a serious overdrafting situation in the lower Salinas Valley. A 1955 Department of Water Resources report estimated a 20,000 acre-foot overdraft of the pressure area in that year with an estimated total withdrawal of 98,400 acre-feet (California Department of Water Resources, 1973a). Total withdrawals have increased significantly since that time, as is indicated by the gradual increase in the size of the intruded area (see Table 8). Agricultural and domestic pumping make up the majority of the withdrawals.

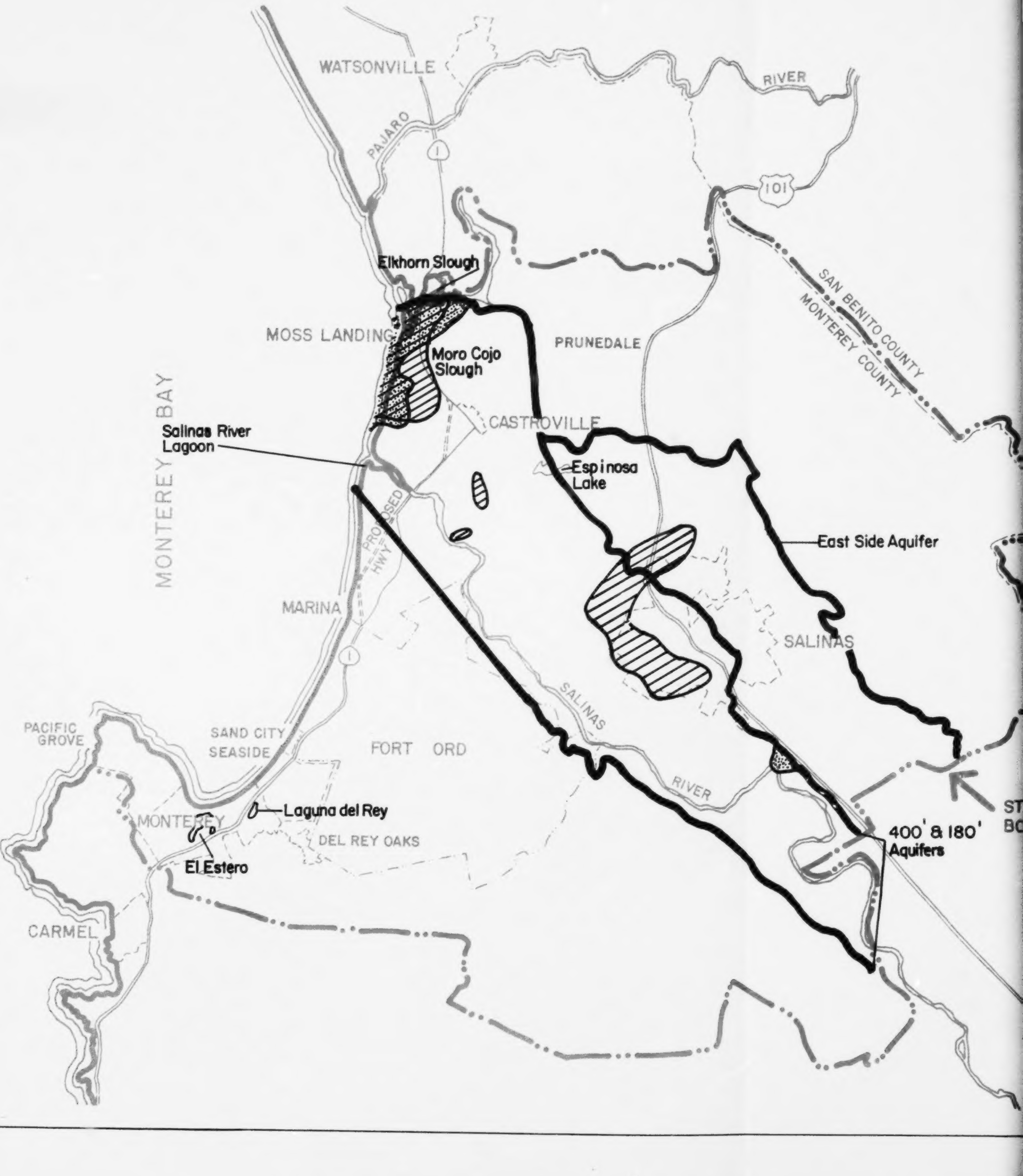
Table 8

AREA OF EFFECTIVE SEAWATER INTRUSION -- ACRES

Groundwater Aquifer	Recorded						Projected	
	1944	1953	1960	1965	1970	1973	1980	1990
180 foot	1,800	5,200	6,700	7,600	8,100	9,700	[10,700]	[12,800]
400 foot	--	--	0	200	1,200	1,900	[3,400]	[5,500]

Source: U. S. Bureau of Reclamation, 1974.

Many wells drawing from the 400-foot aquifer as much as a mile inland between Moss Landing and the Salinas River have been abandoned as TDS concentrations have exceeded 1,500 mg/l. Similar high levels in the 180-foot aquifer extend inland beyond Castroville (Monterey County Flood Control and Water Conservation District, 1976). This increasing problem has forced agriculturalists to make adjustments in their water sources. Some have drilled their wells deeper to find better quality water; others have piped in better quality water from adjacent wells and blended water to reduce the salt problem. In many cases additional water must be added beyond the needs of *evapotranspiration* to leach the excess salts from the soil column. To date there has been no radical change in crop type or actual land abandonment caused by the intrusion, as the farmers have managed to locate water of sufficient quality to irrigate their crops. If intrusion continues to advance at its present rate, however, the remaining good quality groundwater will also become unfit for use. This possibility has prompted planning for the Castroville Irrigation Project, a scheme to pipe Salinas River surface flows from near Salinas to the Castroville area.


WATSONVILLE
PAJARO
RIVER
1
101
Elkhorn Slough
MOSS LANDING
Moro Cojo Slough
PRUNEDALE
SAN BENITO COUNTY
MONTEREY COUNTY
MONTEREY BAY
Salinas River Lagoon
CASTROVILLE
Espinosa Lake
PROPOSED HWY
East Side Aquifer
MARINA
1
SALINAS
SALINAS RIVER
PACIFIC GROVE
SAND CITY
SEASIDE
FORT ORD
Laguna del Rey
MONTEREY
DEL REY OAKS
El Estero
400' & 180' Aquifers
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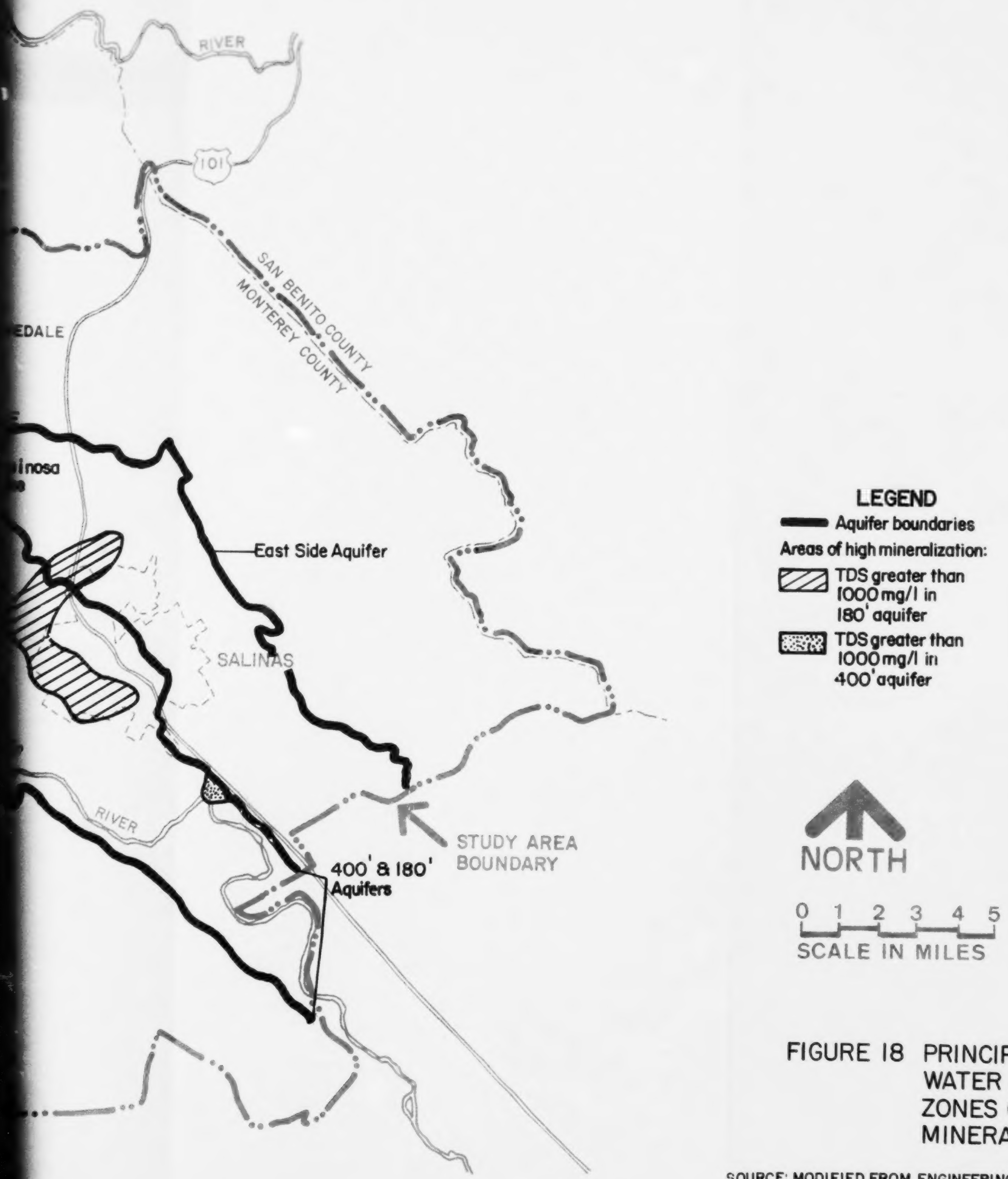


FIGURE 18 PRINCIPLE GROUND WATER AQUIFERS AND ZONES OF HIGH MINERALIZATION

SOURCE: MODIFIED FROM ENGINEERING SCIENCE INC., 1975

The inland progression of intrusion is illustrated in Figure 19. If this trend of intrusion is not halted or an alternative supply of higher quality water is not found, hundreds of acres of the best agricultural land in the state could eventually be subject to undesirable changes in agricultural use and value.

The unconfined East Side aquifer has some hydraulic continuity to the 180- and 400-foot pressure aquifers. As the East Side aquifer is pumped during the irrigation season, the water level drops rapidly, often to 50 feet below mean sea level. This lowering creates a descending hydraulic gradient between the pressure aquifers (180 and 400 foot) and the East Side aquifer, and groundwater moves from the two pressure aquifers to the East Side aquifer. This intensifies the influx of sea water into the 180- and 400-foot aquifers.

The general water quality of the 180-foot, 400-foot and East Side aquifers is extremely variable. For this reason, Table 9 below lists ranges in quality for these aquifers rather than specific estimates.

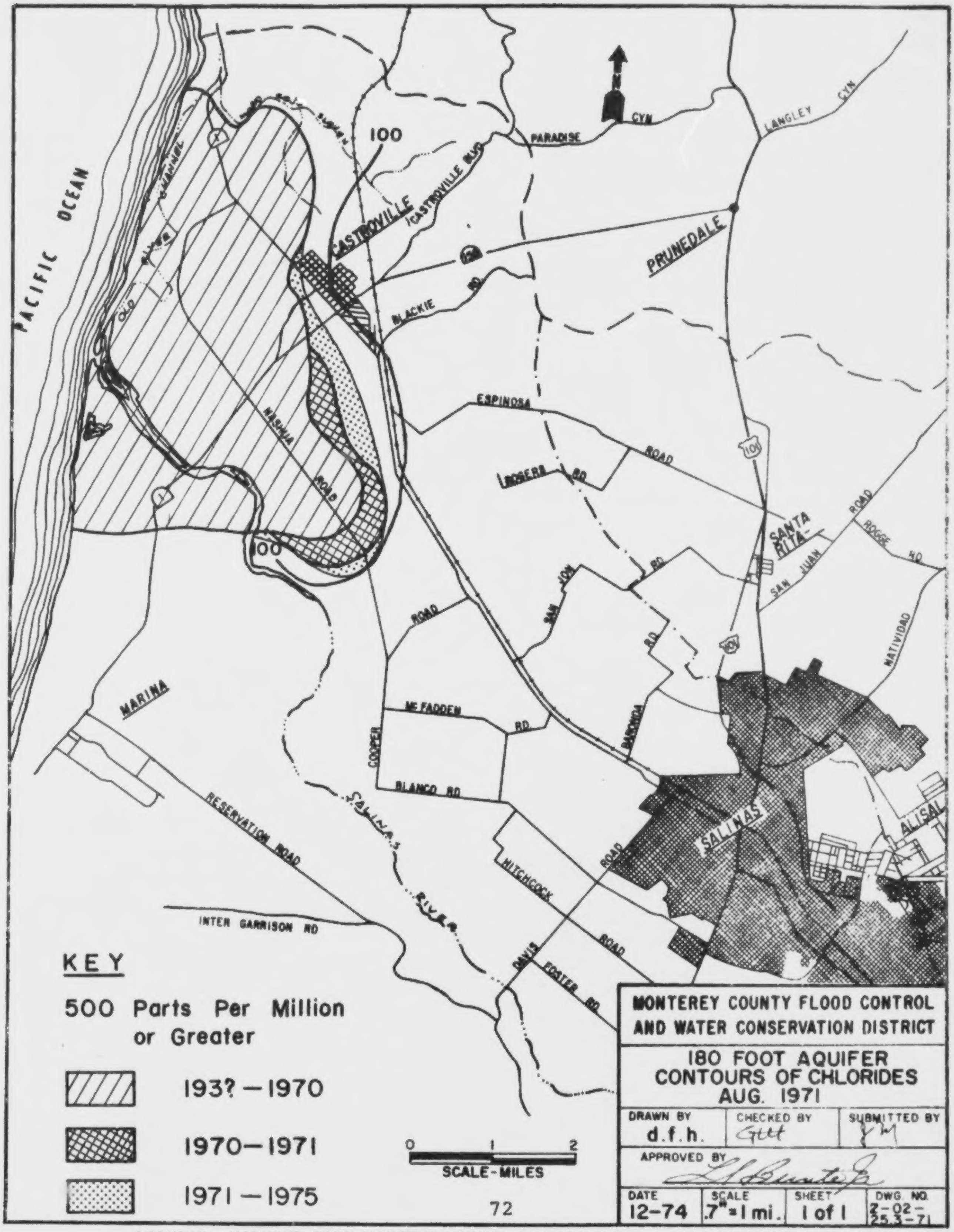
Table 9

GENERALIZED GROUNDWATER QUALITY IN THE SALINAS RIVER BASIN (mg/l)

Characteristic	180-Foot Aquifer	400-Foot Aquifer	East Side Aquifer
TDS[1]	293-2,751	276-2,541	295-1,582
Boron[2]	.00-.70	.00-.10	.00-.10
Sodium[2]	27-252	24-315	54-93
Chloride[1]	22-1,200	22-1,100	37-460
Nitrate[2]	.0-88.0	.0-21.0	4.2-36.0
Sulfate[2]	5.8-432	12-72	---

[1] Source: California Department of Water Resources, 1973a.
[2] Source: California Department of Water Resources, 1973, 1974.

FIGURE 19 PROGRESSION OF SEA WATER INTRUSION IN THE 180' AQUIFER*



*SOURCE: MODIFIED FROM MONTEREY COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT, ND.

Monterey Bay Environment.

Morphology and Hydrography. Between the headland of Pt. Pinos at Monterey (ca. 36° 38' 30"N) and Soquel Point to the east of Santa Cruz (36° 57' 15"N) the coast of California bends eastward to form an elliptical indentation, or bight, along a low-lying sandy shore and at the head of a deep submarine canyon (Figure 20). The long axis of this ellipse, which lies just inshore of the two headlands, is about 25 statute miles or 41 kilometers, and trends slightly to the west of True North (about 8°W or 352°). The short axis of this ellipse projected westward into the ocean would be about 15 statute miles. The mid distance of the bay is at the head of the Monterey Submarine canyon at Moss Landing, which is also the site of Elkhorn Slough, a former mouth of the Salinas River. There is no natural boundary between Monterey Bay and the sea, and it is significant that no attempt to estimate the area of the bay has been made by those who have studied it. Monterey Bay is actually a remarkably symmetrical bight. With its symmetrical shoreline and gently sloping bottom (except for the central gouge of the submarine canyon), it resembles a broad-rimmed bowl with most of one side broken off.

Although broadly open to the sea, the shore of Monterey Bay is not a completely exposed coastline because of the wave refraction around the headlands. The bottom of the bay slopes gently toward the rim of the submarine canyon. The 60-foot contour lies 2,000 feet offshore in the southern part of the bay and 12,000 feet offshore in the northern part. South of the canyon the bottom slopes more steeply than it does to the north, but not markedly so; the main difference is that in the northern third of the bay, the 20-fathom (about 120 feet) and 10-fathom (about 60 feet) contours are much farther apart than in the southern section; there is a greater area of shallow, gradually sloping bottom north of the submarine canyon. At the head of the canyon near Moss Landing, there is a steeper slope at the 100-fathom (600 foot depth) line than farther out in the bay. (On the relief model of Monterey Bay, made some years ago by Harold Heath and now hanging in the hall of the Loeb Building at Hopkins Marine Station, the slope of the bottom from shore toward the rim of the canyon is almost imperceptible because no vertical exaggeration of scale was attempted.)

As might be expected from this circumstance, the bottom sediments are more or less evenly graded according to the bottom contours (Figure 21), from "very fine sand" at about the 20 fathom line to inland of the 10 fathom line where the bottom is "fine sand" to the nearshore bottom and beach of "coarse and medium sand". The slope and bottom of the submarine canyon nearshore are characterized by silt and clay,

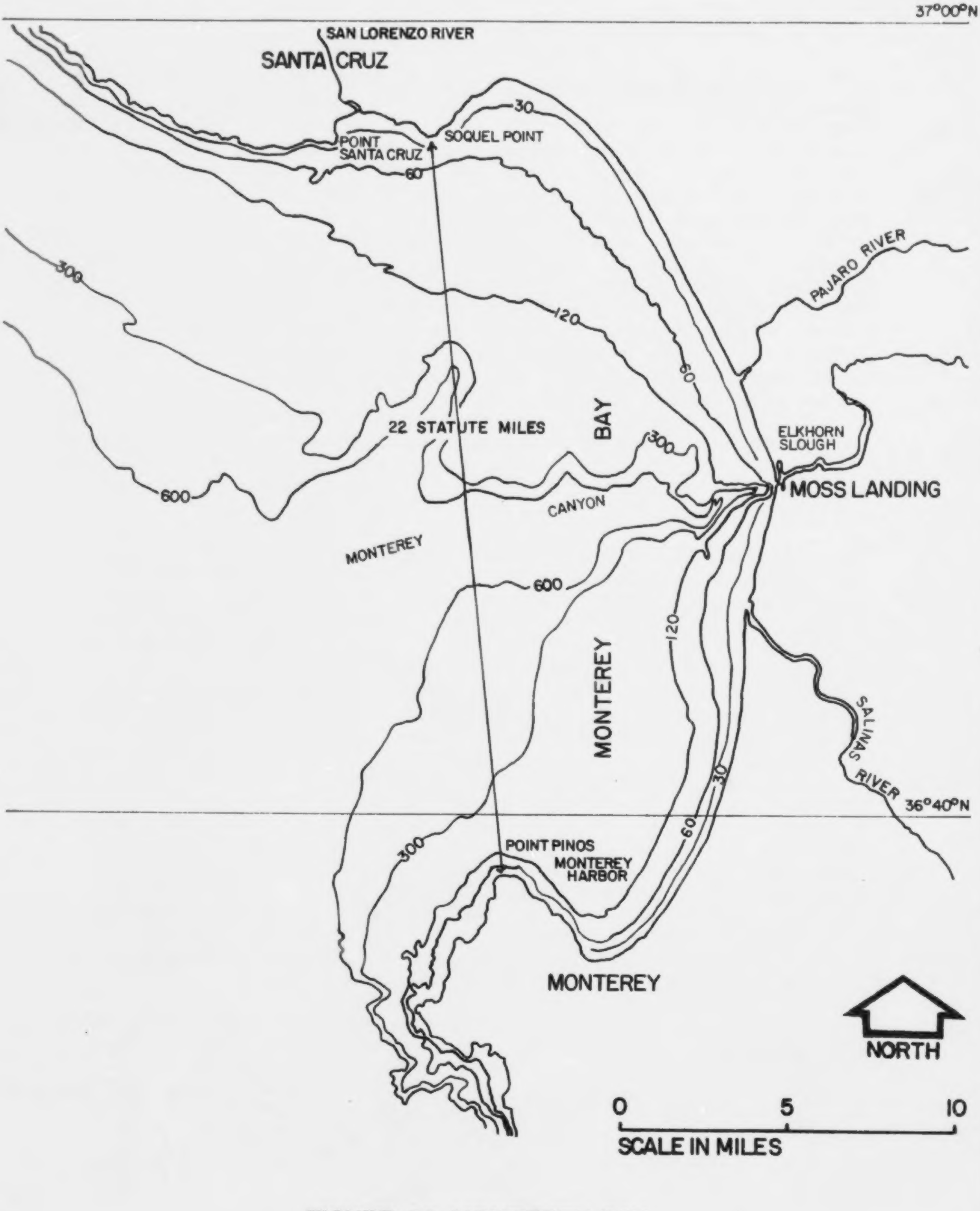
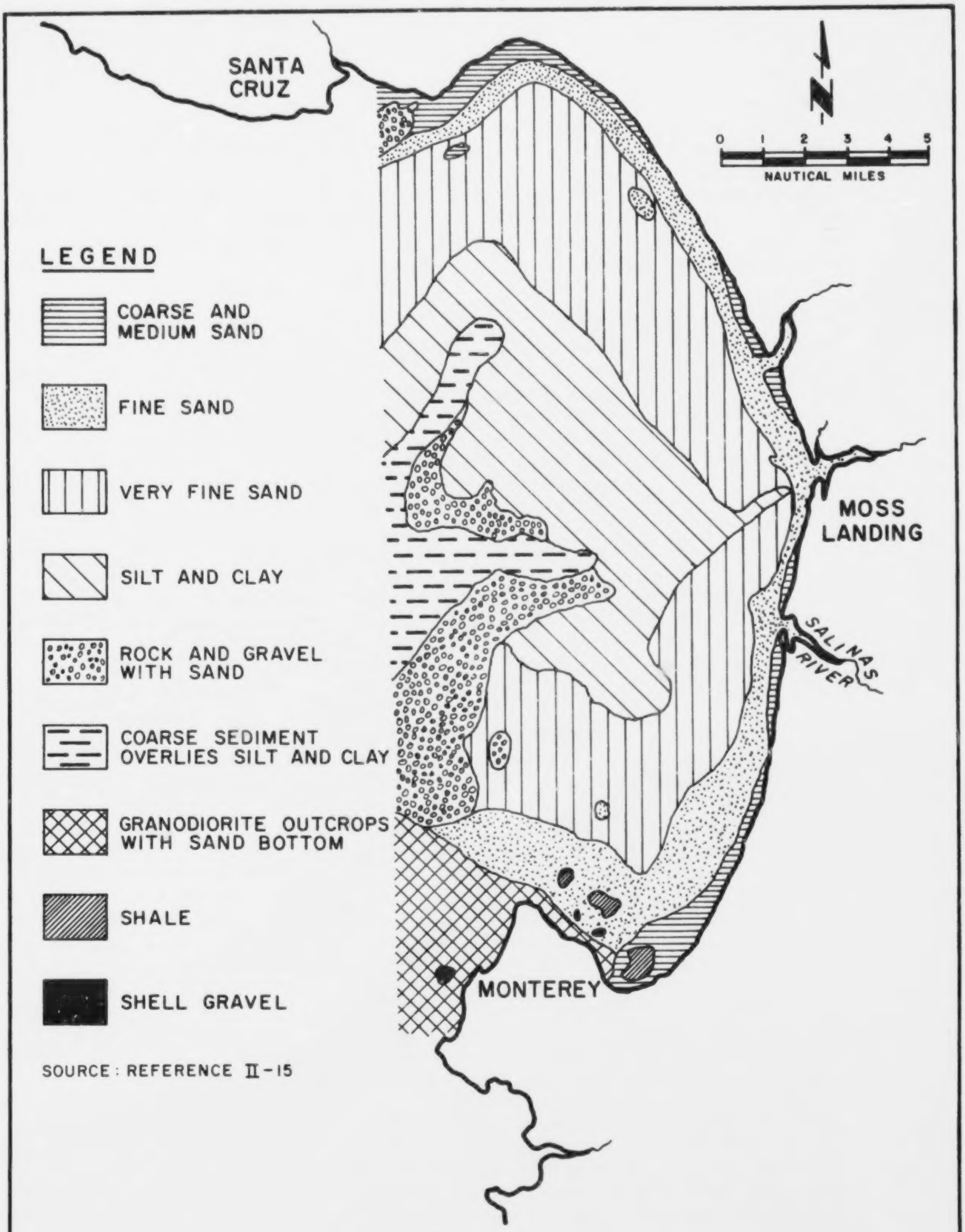


FIGURE 20 MONTEREY BAY



SOURCE: REFERENCE II-15

FIGURE 21
DISTRIBUTION OF
SEDIMENT TYPES IN MONTEREY BAY

grading to gravel and coarse sediments in the deeper part between the headlands. As a result of topography and wave action, there is a pronounced sorting of the sand so that "coarse and medium sand" is concentrated in the southern part of Monterey Bay below the Salinas River, with an associated buildup of dunes behind the shore. Some of this sand has been mined commercially for many years.

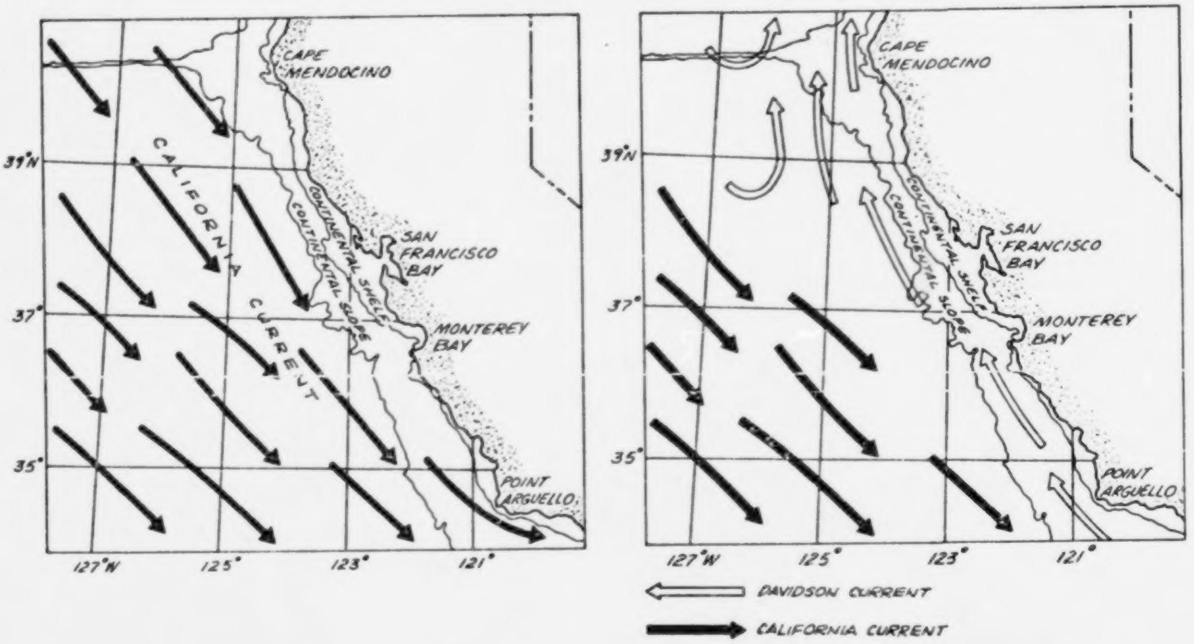
Currents in Monterey Bay. In a 1936 report, Tage Skogsberg remarked that "a study of the *hydrography* of Monterey Bay therefore becomes rather a study of a section of the open sea than a study of a region in which hydrographic peculiarities may be traced to local topographic and meteorological conditions". While there have been some modifications of this view, it is still substantially true that this region is more a part of the ocean in its hydrographic conditions than a bay; certainly its temperature and salinity conditions are oceanic in character.

The major current of the California coast is the southward moving California current lying usually some miles offshore. Near shore there is a counter current at about 200 meters depth moving northward. During the autumn and winter months (about November or December to February), this current reaches the surface and is known as the Davidson current (Figure 22).

In general, the coastal currents move shoreward into Monterey Bay as a broad, slow-moving, open eddy at a speed of less than half a knot. When the movement is northerly, a small clockwise eddy is built up in the southern part of the bay behind Pt. Pinos (Figure 23); southerly movement past Santa Cruz tends to form a small counter clockwise eddy in the north. On the whole, however, the current movement in Monterey Bay follows the isobaths (lines of equal depth) in and out of the bay with little tendency toward vertical mixing even in the vicinity of the submarine canyon. Tidal influences are also slight, because of the open nature of the bay.

During the spring and summer, when the winds are strong out of the north and northwest, the surface water is pushed offshore from the coast, and subsurface water from depths of less than 200 meters moves toward shore and surfaces at the coast. This upwelling of cold nutrient-rich water is especially pronounced to the lee of headlands, but it occurs as far as 50 km offshore. Questions have been raised as to whether wind is the driving force of upwelling in Monterey Bay, but this appears to be the cause. Upwelling contributes some nutrient water to the bay, but vertical movement is so slight compared to horizontal surface movement in Monterey Bay that it has no significant effect on mixing.

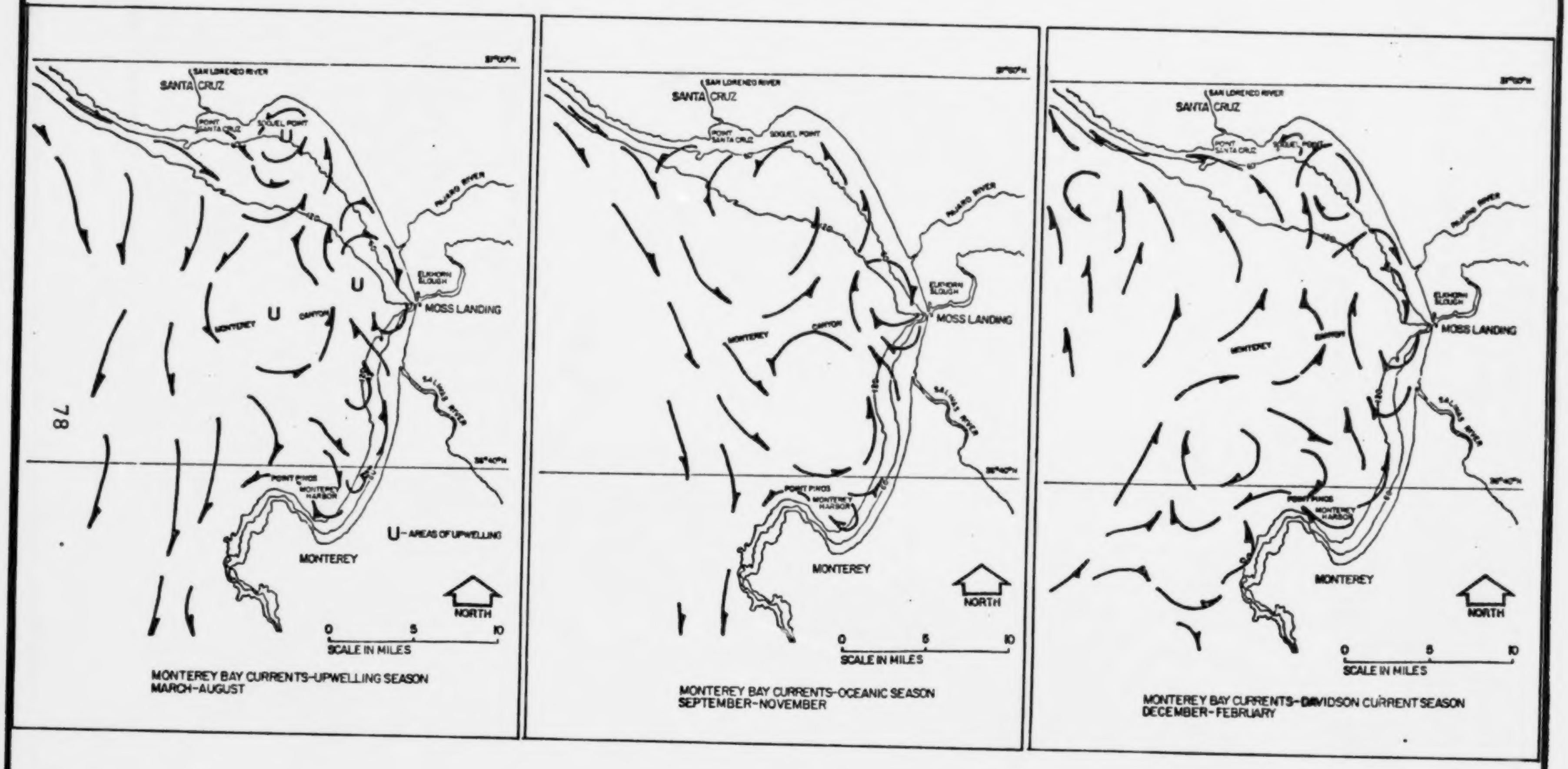
FIGURE 22 MAJOR CALIFORNIA COASTAL CURRENTS



PREVAILING SUMMER CURRENTS OFF THE CENTRAL CALIFORNIA COAST

PREVAILING WINTER CURRENTS OFF THE CENTRAL CALIFORNIA COAST

SOURCE: BROWN & CALDWELL CONSULTING ENGINEERS, 1971



MONTEREY BAY CURRENTS-UPWELLING SEASON
MARCH-AUGUST

MONTEREY BAY CURRENTS-OCEANIC SEASON
SEPTEMBER-NOVEMBER

MONTEREY BAY CURRENTS-DAVIDSON CURRENT SEASON
DECEMBER-FEBRUARY

FIGURE 23 MONTEREY BAY SEASONAL SURFACE CURRENT PATTERNS

SOURCE: PIRIE & MURPHY, 1975

Though arbitrary, it is convenient to divide the year into three "oceanographic seasons" when describing surface currents: the upwelling period from March to August, the oceanic period from September to November, and the Davidson current period from December to February.

During the upwelling and oceanic periods, collectively referred to as the California current season, the general surface current pattern is from north to south, driven by the California current and prevailing winds (Pirie and Murphy, 1975) (see Figure 23). Counterclockwise eddies or gyres form in the northern and southern ends of the bay. Relatively weak currents in the oceanic period result in poor circulation of surface waters and possibly contribute to red tide conditions frequently observed in these months. Gyre velocities are greater (0.1-0.5 knots) during the upwelling period. A third but smaller clockwise eddy often forms offshore from Moss Landing during these two periods.

During the Davidson current season, Monterey Bay surface flows move generally from south to north, driven by the northward flowing coastal current which protrudes into the bay. Three clockwise gyres form at the surface (Figure 23). The orientation of the Monterey Submarine Canyon tends to funnel a high volume of water into the bay during this period (Pirie and Murphy, 1975).

Temperature. Water temperatures are generally lowest during the upwelling period (10-11°C or 50-52°C). In the northern and southern parts of the bay, temperatures may be higher by 3°C (5°F) or more during this period. As the upwelling dies off and the oceanic period sets in, temperatures are warmer and reach their annual maxima of 13 to 16°C (55-61°F). During these oceanic and upwelling periods, a *thermocline* (a layer in a thermally stratified water body that separates a warmer, lighter zone of water from a colder, denser zone) of 3°C (5°F) or more is developed in the upper 50 meters, influenced by upwelling. During the Davidson current period, surface temperatures vary less than 1°C (1.8°F) over the bay and there is a gradient of less than 1°C in the upper 50 meters of water. This temperature progression may vary from month to month during the year, but is in general fairly consistent (Figure I-4).

Salinity. The surface salinity of Monterey Bay is seldom below 33 parts per thousand or above 34 parts per thousand; the highest salinities occur during the end of the upwelling period and the lowest during the rainfall and runoff periods. Most of the area draining into Monterey Bay receives 16-20 inches of precipitation annually. Much of the annual flow of water has been appropriated for agriculture and domestic supply, and therefore does not reach the ocean to affect salinity.

Water Quality. The quality of Monterey Bay waters is influenced by the natural oceanographic conditions described above and man's activity on the land, including disposal of wastes. There are currently 8 domestic wastewater and 2 industrial discharges directly to the bay (Figure 24); in addition, several streams and sloughs carry agricultural, industrial and domestic wastes and sediments into the bay. The growing influence of man's activity on bay water quality has prompted numerous studies of local water management and waste disposal systems, including preparation of the North Monterey County Facilities Plan.

The bacterial contamination of the bay has been of concern to local and state health departments for several years. A 1970 study (Monterey County Health Department et al, 1970) determined that there were unacceptably high coliform counts in near shore waters in the vicinity of most of the domestic wastewater ocean discharges. This contamination is a health hazard to both water contact sports and shellfish harvesting. Table E-6 presents some of the study's findings. Many of the coliform counts exceed the SWRCB near shore ocean waters standard of 1000 MPN/100 ml (California State Water Resources Control Board, 1972) and the RWQCB shellfish area standard of 70 MPN/100 ml (California Regional Water Quality Control Board, Central Coastal Region, 1974). Recreational use of the beaches, including clamming, swimming and fishing, have in the past been a major drawing point for both tourists and residents and is therefore an important aspect of the local economy. The shallow depths and short lengths of existing outfalls allow contaminated wastewater to be transported inshore toward recreation areas by tidal currents without receiving significant dilution. Many of the bacteria and viruses present in domestic wastewater are pathogenic and are therefore a hazard if ingested.

The AMBAG Water Quality Management Plan (Yoder-Trotter-Orlob & Associates, 1973) further identified water quality problems developing in Monterey Bay. An analysis of the bay's circulation pattern identified pockets and sluggish circulation areas in both the north and south ends of the bay. The wastewater outfalls in these pockets (see Figure 24) are suspected of contributing to nutrient build-ups, occasional algae blooms, and coliform concentrations. There are little data on heavy metals concentrations. Nutrient build-ups also occur near the entrance to Moss Landing Harbor, but this is related to periodic upwelling of deeper water, not waste discharges. The problems related to poor circulation have prompted the RWQCB to establish a wastewater discharge prohibition area inside a line drawn from Pt. Pinos to the mouth of the Salinas River (Figure 24). The Pacific Grove, Monterey, Seaside, Ft. Ord, and Marina ocean outfalls are inside this prohibited zone and must now be relocated or eliminated.

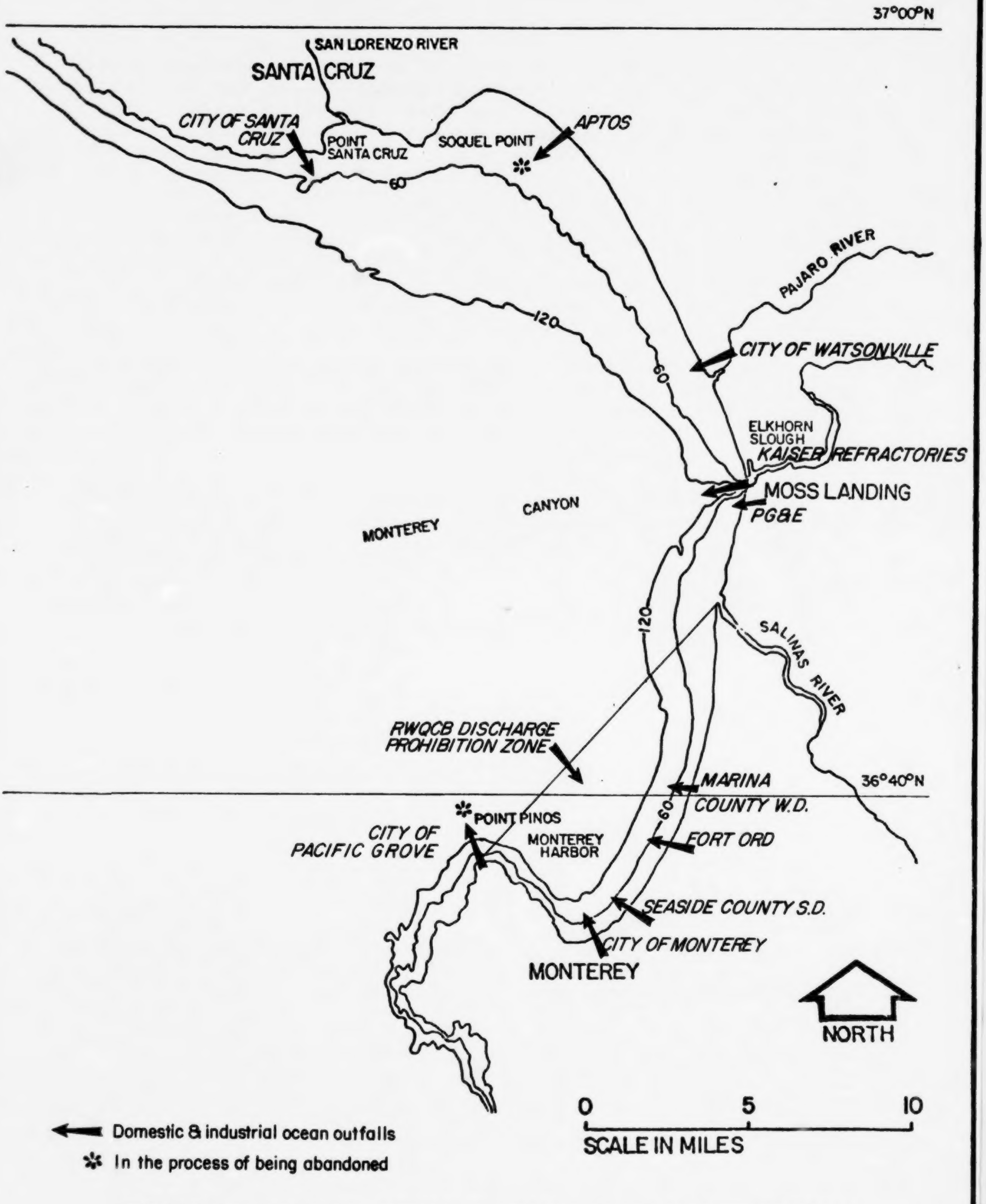


FIGURE 24 EXISTING OCEAN DISCHARGES TO MONTEREY BAY

The AMBAG Plan also identified an area of probable pesticide build-up in the bay between Elkhorn Slough and the Salinas River (Figure 25). Runoff from these two inland waters carries a significant volume of agricultural land runoff and domestic wastewater which contain pesticide loads (see Table E-2). The high pesticide loads are potentially hazardous to marine life inhabiting the area and any animals that come to the area for food. This includes man. Some pesticides are accumulated and concentrated as they pass through the food chain and may eventually reach levels which can impair growth, result in reproductive failure, or cause chronic illness. Reproductive failure in brown pelicans has been attributed to high pesticide concentrations within their food chain.

AMBAG is conducting a non-point source water pollution study which is aimed at identifying and reducing pesticide and other pollutant contamination of the area's surface waters and the bay. No data were found on current pesticide levels in Monterey Bay sediments.

Kaiser Refractories and Pacific Gas and Electric Company have industrial ocean discharges in the Moss Landing area (Figure 24). The PG & E outfall carries only sea water that has been used in cooling electrical power generator turbine condensers. The returned sea water has an average temperature of 75°F. Table 10 summarizes the characteristics of the Kaiser outfall. Both extend approximately 800 feet offshore.

TABLE 10

KAISER INDUSTRIAL DISCHARGE QUALITY
1973 SUMMARY*

Ave. Daily Flow	28.72 mgd
Ave. pH	10.1
Ave. Temp.	19°C (66°F)
Turbidity	51 JTU
Sus. Solids (daily)	22,800 lbs. (primarily magnesium oxide and calcium oxide)**
Settleable Solids (daily)	Trace (<0.1 ml/l)

* Source: Data supplied in personal communication from Regional Water Quality Control Board, Central Coast Region, 1976.

** Source: Roger Briggs, personal communication.

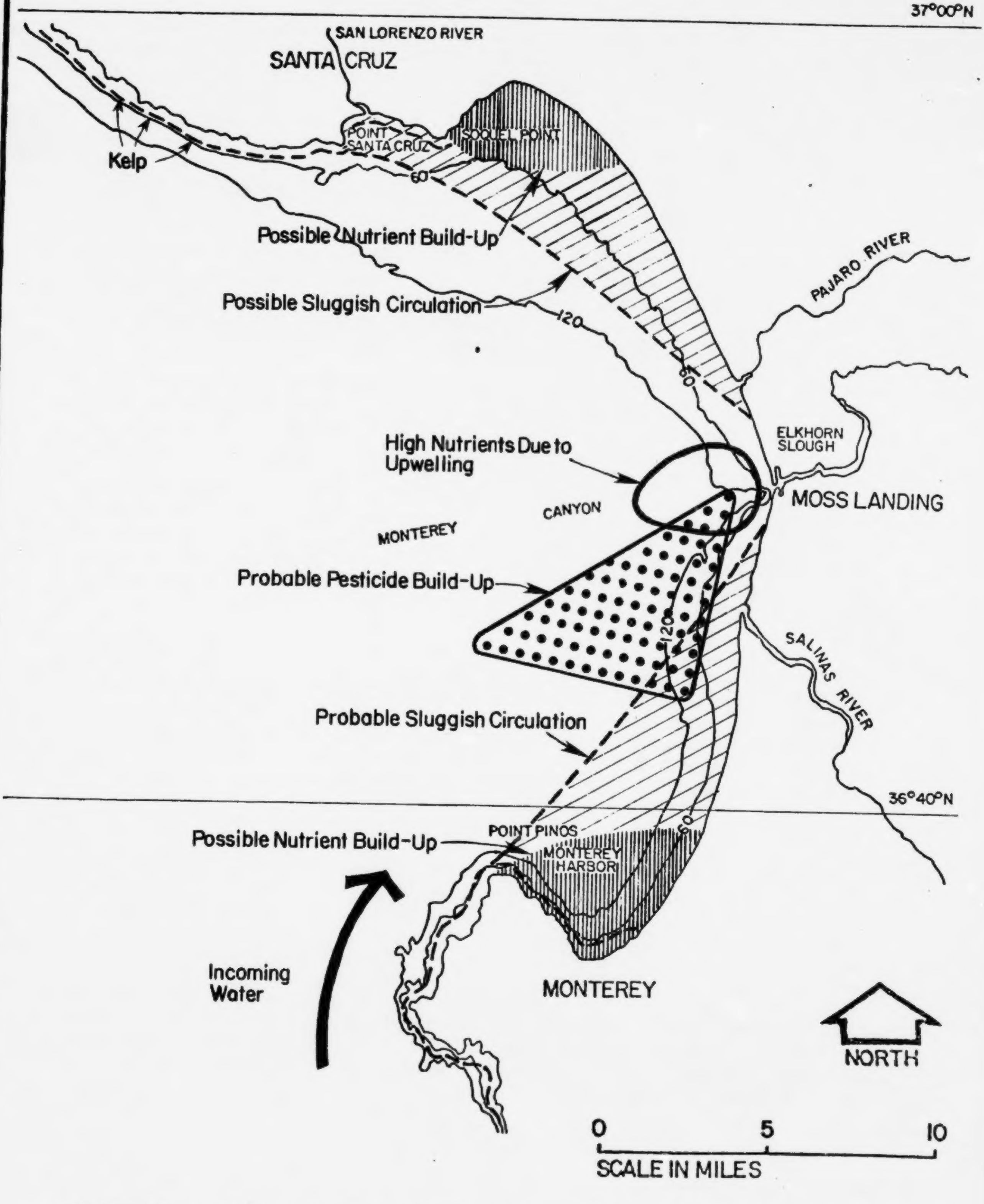


FIGURE 25 DISTRIBUTION OF FACTORS AFFECTING MONTEREY BAY WATER QUALITY

SOURCE: OCEANOGRAPHIC SERVICES, INC, 1973

Marine Organisms. The nutrient concentrations that build up during the upwelling period fall off toward the end of September; this pattern of annual variation is reflected in the standing crop of *phytoplankton* (Figure I-4). Usually phytoplankton is highest in May and June, but there may be peaks as early as March in some years. The highest *plankton* volumes have been noted during periods of intermittent rather than steady upwelling. Possibly, as Bolin and Abbott (1963) suggest, this is associated with horizontal divergence of surface water rather than low production. In general, the pattern of primary production (the amount of material [or energy] formed by an individual, population or community of green plants during a defined time period) corresponds with that of other parts of the California coast and reflects prevailing oceanographic conditions.

The evenly-graded sand bottom of Monterey Bay does not support the rich assemblage of infaunal species such as deep burrowing bivalves and detritus feeding polychaete worms and the smaller elements associated with Zostera characteristic of more sheltered embayments such as Elkhorn Slough (especially as described by MacGinitie, 1935) in years gone by. Nevertheless, there is a characteristic and rich development of shallow water benthos. In Monterey Bay this conspicuous fauna consists of such crustacea as amphipods and ostracods, a polychaete, several bivalves and the sand dollar (Dendraster excentricus).

There is at times a grouping referred to as an amphipod-ostracod-sand dollar association (a group of species that tend to occur together), but data from repeated sampling at several localities show considerable variation in the comparative composition of the samples (Figure I-1). Most notable is the absence of sand dollars from several stations until the last set of samples. This suggests either the sample location was changed, or more likely, because of the fairly uniform appearance of the sand dollars at all the stations, that they tend to move about and this set of samples may therefore indicate a shift at a bottom assemblage associated with the movement of sand dollars. It is this tendency of animals on sandy bottoms to move about that makes it difficult to characterize the benthic life of Monterey Bay. The two most characteristic organisms of the *intertidal* and *subtidal* region of Monterey Bay are the egg-shaped sand crab (Emerita) and the pismo clam, now greatly depleted both by clam diggers and by sea otters. The sporadic occurrence of these and other animals occurring in intertidal sandy beaches is well known. Good and bad years may be associated with the fate of swarms of larvae, in turn related to variations in nearshore currents.

Monterey Bay has been one of the most significant fisheries regions of the California coast. In times past, it was briefly the major fishing port of the country during the great sardine years. Now sardines are not even seen in the Monterey area. Many of the fishes now caught commercially in Monterey Bay are bottom feeders, and the location of the principal fishing grounds is an indication of a productive benthic invertebrate fauna that sustains them (Figures I-2 and I-3). Table 11 gives an indication of the change in principal fish species landed in the Monterey Bay area since 1947.

There are no significant kelp beds in Monterey Bay proper, that is, between Pt. Pinos and Soquel Point, except for a few associated with the sandstone reefs around Soquel Point. Most of the important kelp beds are north of Santa Cruz and off Pt. Pinos and southward to Point Lobos.

Biological Resources

Vegetation.

There are diverse vegetation types in the study area. Many of the native plants are extinct or near extinction (See Table 12). These have been supplanted by introduced species from Europe and Asia which are so widespread (i.e., wild oats, various thistles and other grasses) that they are considered naturalized.

Vegetation will be discussed here in terms of vegetative cover types. (A cover type is an assemblage of plants with a characteristic species composition and arrangement.) The vegetative cover types found in the study area (Figure 26) are briefly described below.

Coastal Dunes. There are coastal dunes along the central and southern edge of Monterey Bay from Moss Landing to Seaside. Shifting sand dunes just behind the beach have *prostrate* and succulent plants, while dunes farther inland have more erect woody plants. The prostrate plants form a low, fairly continuous mat in some locations, while in other spots they exist as small islands on the open sand. The woody plants of the rear dunes normally range from 2-4 feet in height and often form a dense cover, nearly obscuring the dune itself. Dune vegetation is fragile; it is easily damaged by foot travel, as well as by construction.

Table 11

HISTORICAL TREND IN COMMERCIAL FISH *LANDINGS* -- MONTEREY REGION

	Pounds Per Year			
Fish	1947	1962	1968	1971
Anchovy	15,495,816	1,188,097	8,501,799	2,409,040
Cabezone	2,832	1,920	9,678	
Flounder	64,654	38,505	59,764	16,600
Halibut	135,378	47,181	79,340	45,004
Herring	923,224	492,825	304,634	207,550
Kingfish	195,227			
Lingcod	64,192	101,428	71,318	264,299
Mackerel, jack	2,153,019	2,049,729	960,612	163,673
Mackerel, Pacific	373,892	6,287		
Perch	49,349	25,977	13,727	27,984
Pompano, California	137,381	562	71,748	3,786
Rockfish	1,521,275	2,854,868	2,394,655	2,398,283
Sablefish	162,902	404,628	1,329,969	1,195,077
Salmon	738,469	308,369	572,605	270,772
Sanddab	51,003	127,863	172,631	88,023
Sardine	36,773,189	2,591,518	1,280	
Sea bass, black	249		66	
Sea bass, white	26,057	2,400	14,999	
Shark	781,558	60,488	60,620	
Smelt	111,180	75,691	49,317	18,843
Sole	421,756	526,920	903,043	717,690
Swordfish	521			
Tuna, albacore	1,272,410	2,685,605	1,421,311	10,335,870
Turbot	4,746	70	85	
Miscellaneous fish	1,045	122,502	943	

Crustacean	1947	1962	1968	1971
Crab	51,851	12,458	1,215	
Shrimp	1,687			
Prawn		694	7,239	11,747

Mollusk	1947	1962	1968	1971
Abalone	148,736	125		
Clam, gaper	2,656	480		
Clam, Pismo	2,438			
Mussel	530			
Octopus	7,401	61	381	
Oyster, giant Pacific		31,668		
Squid	14,443,859	5,652,857	14,578,091	16,646,423
GRAND TOTAL	76,132,076	19,630,286	31,863,143	34,820,664

Source: California Department of Fish and Game, 1949, 1964, 1970, 1973.

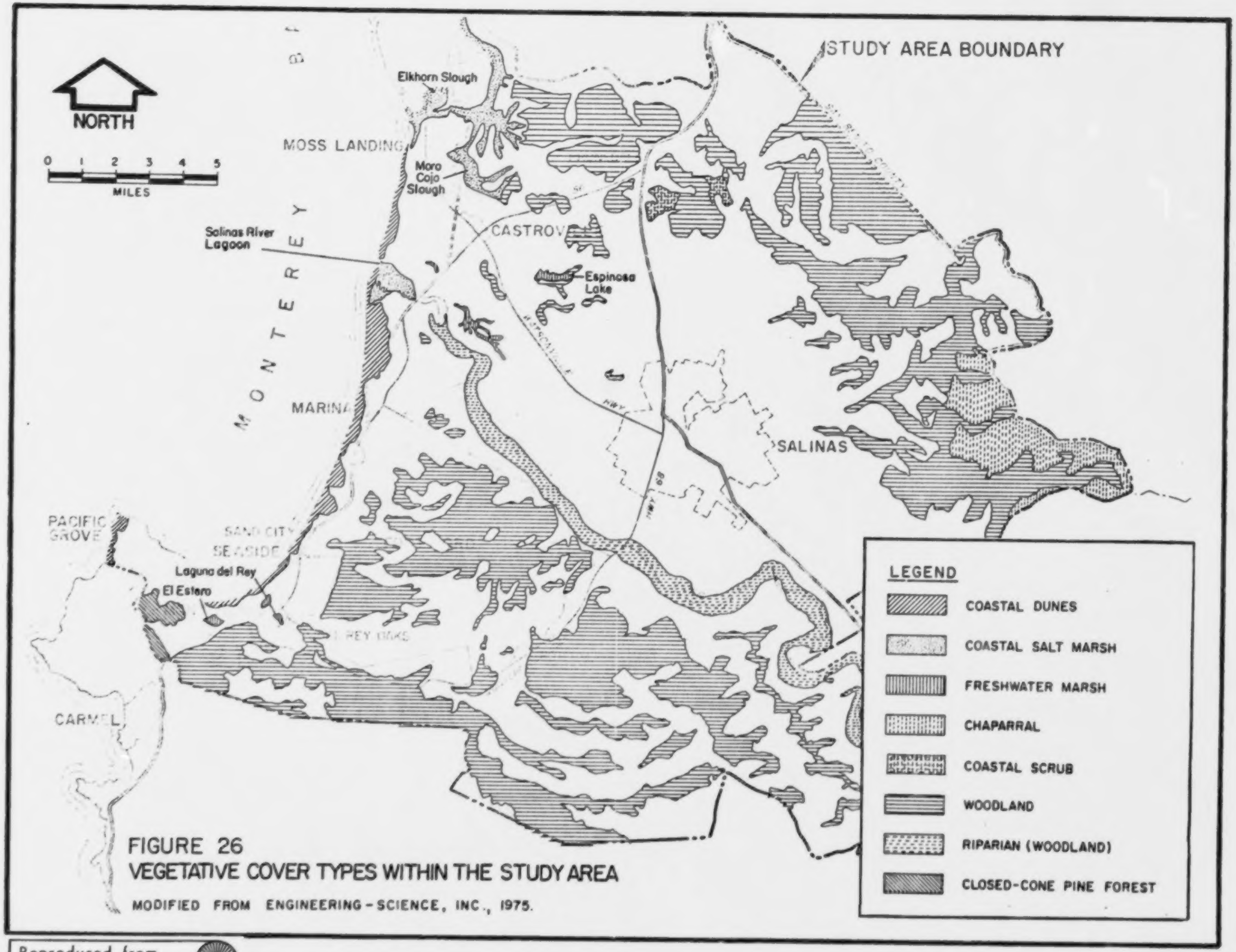


FIGURE 26
VEGETATIVE COVER TYPES WITHIN THE STUDY AREA

MODIFIED FROM ENGINEERING-SCIENCE, INC., 1975.

Reproduced from best available copy.

Common plants in the foredune area are silky beach pea (Lathyrus littoralis), sea rocket (Cakile edentula ssp. californica and Cakile maritima), sand verbena (Abronia maritima), New Zealand spinach (Tetragoma expansa) and various species of ice plant (Mesembryanthamum spp.). Coast eriogonum (Eriogonum latifolia), marram grass (Amophila arenaria), blue beach lupine (Lupinus chamissonis), and mock heather (Haplopappus ericoides) are found in the rear dune areas.

Salt Marsh. There is coastal salt marsh in Elkhorn Slough, to a limited extent in Moro Cojo Slough, and in portions of the Salinas River channel from the Highway 1 Bridge to the Pacific Ocean. Before the mouth of the Salinas River moved from Elkhorn Slough to south of the slough, both Elkhorn and Moro Cojo Sloughs were probably seasonal freshwater marshes with extensive tidal intrusion only during dry months or dry years. Moro Cojo Slough, blocked by a tide gate at the Highway 1 Bridge, is now primarily a brackish water marsh, while Elkhorn Slough is a marine estuary or lagoon, with freshwater marsh only at the inland margin, where overland runoff enters.

There are about 1,440 acres of salt marsh in Elkhorn Slough (Browning, et. al., 1972). The littoral zone (subject to tidal submergence) is a tidal mudflat, with no vegetation right next to the slough. There are extensive areas of perennial pickleweed (Salicornia spp.), comprising over 90 percent of the vegetation. (Browning, et. al., 1972). In higher marsh fringes where tidal inundation is rare, salt grass (Distichlis spicata) and Frankenia (Frankenia grandifolia) occur. These species form a low, dense mat of vegetation along and in between the small tidal sloughs that periodically overflow and inundate most salt marshes. Eel grass (Zostera marina) grows in a few locations in the harbor and mouth of the slough.

There is about 63 acres of salt marsh along a 1-1/2 mile stretch of the lower Salinas River between the ocean and the Highway 1 bridge. The largest contiguous piece is located near the coast immediately south of the river; it is presently part of a California Department of Fish and Game Wildlife Area. The remainder is a thin band upstream toward the bridge. Dominant plant species are pickleweed and salt grass.

Freshwater Marsh. There are small areas of freshwater marsh in the study area around springs, ponds and streams, especially at Espinosa Lake, Laguna del Rey, El Estero, Salinas River, Bennett Slough, and upper portions of Elkhorn and Moro Cojo Sloughs. Freshwater marsh environments were more common in Elkhorn and Moro Cojo Sloughs before the change in the course of the Salinas River. Common plants found in these freshwater marshes are common tule (*Scirpus acutus*), bulrush (*Scirpus californicus*), cattail (*Typha* spp.) and sedge (*Carex* spp.). The tall, slender cattails and tules form dense stands on the perimeter of permanent standing water; heights of 6 to 8 feet are not uncommon for these species.

A small, shallow, fresh-to-*brackish* pond with a relatively stable water level lies south of the salt marsh near the mouth of the Salinas River in the California Department of Fish and Game Wildlife Area. The source of this water is not known. Vegetation surrounding the pond is primarily pickleweed and salt grass. This has been historically and continues to be a waterfowl hunting area.

Chaparral. Chaparral plant communities form dense masses of vegetation on dry gravelly slopes in the foothills of the Gabilan Range east of Salinas. The broad-leafed, woody species that make up this community range in height from 3-6 feet or more and often form a thick, nearly impenetrable barrier to foot travel. Characteristic plants are chamise (*Adenostoma fasciculatum*), manzanita (*Artostaphylos* spp.) and toyon (*Heteromeles arbutifolia*). This vegetation type has been cleared in many locations to provide more open grassland for cattle grazing.

Coastal Scrub. This vegetative type grows on dry gravelly slopes in the northern portion of the study area near Prunedale. It often forms dense stands similar to chaparral, but is considerably lower in height, with smaller, less rigid trunk and branches. Characteristic plants are coyote bush (*Baccharis pilularis*), coastal sage (*Artemisia californica*), black sage (*Salvia mellifera*), blackberry (*Rubus vitifolius*), and bush monkey flower (*Mimulus aurantiacus*). Some chaparral species such as manzanita and chamise may also be intermixed with the coastal scrub.

Woodland. The woodland plant cover type is found throughout the study area, and its most characteristic plant is the oak (*Quercus* spp.). Woodland areas range from nearly continuous, dense stands of oaks with little *understory* vegetation to open "oak parkland" with scattered brush or grassland beneath and between the trees. Different species of oak are found, depending on local soil and climatic conditions. Principal species are the blue oak (*Quercus douglasii*), black oak (*Q. kellogii*), valley oak (*Q. lobata*), coastal live oak (*Q. agrifolia*), and interior live oak (*Q. wislizeni*). The blue oak and interior live oak are found primarily on the west slopes of the Gabilan Range. The black oak are common in the south Monterey Bay area.

Valley oak are most common on the floor of Salinas Valley, but they also grow on the slopes of the Gabilan Range. Along northern Monterey Bay near Castroville and Moss Landing the coastal live oak is the predominant oak species. The range of these species is not definite and there are many areas of overlap. Brush species such as buckthorn (Rhamnus californicus), buckbrush (Ceanothus cuneatus), yerba santa (Eriodictyon californicum), and poison oak (Rhus diversiloba) are often found associated with oak woodland, as are trees such as buckeye (Aesculus californica) and California laurel (Umbellularia californica).

Riparian Woodland. This cover type is found along watercourses and in canyons where there is natural seepage. The principal area of riparian land occurs along the Salinas River.

Riparian habitat along the Salinas River often has a tall overstory of trees with an understory of shrubs and herbaceous vegetation. However, there are areas more singularly composed of shrubs or herbaceous vegetation. (The vegetative composition of the riparian community is shown in Table H-1). The California Department of Fish and Game has studied and catalogued the vegetation into subtypes along the Salinas River in Monterey County. Vegetative subtypes and acreages of these subtypes found from the Chualar Bridge to the Pacific Ocean (24 linear miles) are listed in Table H-2. A Department of Fish and Game survey indicates there is an average of 102 acres of riparian vegetation per mile along the Salinas River.

Riparian areas, once more extensive and widespread along the Salinas River, are now confined to the stream channel and in most cases within the levee system. In most sections of the river, the riparian woodland is less than 300 feet wide on either side of the river.

Closed-Cone Pine Forest. Closed-cone pine forest is limited in the study area, occurring only at Pacific Grove and certain other planted areas. The stands are frequently dense with little understory vegetation, the trees range from 30 to over 100 feet in height. The principal closed-cone species is the Monterey pine (Pinus radiata). The Del Monte Forest (which borders Pacific Grove on the south) contains several species of plants restricted to the area, i.e., gowen cypress and bishop pine. These species and others are described under "Rare and Endangered Plants". Plants representative of the closed-cone pine forest are Monterey cypress (Cupressus macrocarpa) and coast live oak (Quercus agrifolia).

The California Natural Areas Coordinating Council has designated specific locations throughout the state as natural areas significant for their scientific or educational interest or as representative of California's native biotic communities. Monterey County has a large number of these natural areas; those within the study area are summarized below (California Natural Areas Coordinating Council, 1975):

Asilomar State Beach - a 96-acre site (USGS 7-1/2' quad, Monterey; 37°30'N, 121°56'20"W) of over one mile of shoreline supporting several coastal and inland habitats. The dunes are "probably the best remaining example of the dune vegetation that was once prevalent on the Monterey Peninsula."

Elkhorn Slough - a 2,500-acre marsh and slough (USGS 7-1/2' quads, Moss Landing and Prunedale; 36°48'50"N, 121°45'W) representing one of the largest remaining wetlands on the coast. Over 90 species of birds and 70 species of fish have been found in the area, including the endangered California clapper rail, California brown pelican and California least tern.

Ft. Ord Dunes - a 1,000-acre sand dune area (USGS 7-1/2' quad, Marina; 36°38'N, 121°49'W) along the coast that supports several rare plant species and a variety of native plants that are unique to the Monterey Bay area.

Ft. Ord Botanical Reserves - there are nine separate areas within the confines of Ft. Ord Military Reservation (USGS 7-1/2' quad, Seaside) that support botanical complexes of particular interest. All of the protected reserves contain unique and/or rare plant species. The plant complexes offer some of the best remaining examples of the vegetation that existed along Monterey Bay prior to man's intervention.

Monterey County Airport and Vicinity - a 300-acre site (USGS 7-1/2' quad, Seaside; 36°35'N, 121°50'W) south of the airport that was once one of the "richest" floristic areas on the Monterey Peninsula. It now supports a number of rare plants.

Moro Cojo Slough - a 600-acre freshwater marsh and estuarine area (USGS 7-1/2' quad, Moss Landing; 36°47'30"N, 121°46'W), similar to Elkhorn Slough, but with more freshwater influence. The slough is an excellent area to study life form transitions from estuary to freshwater marsh.

Pacific Grove Monarch Butterfly Trees - a 1/4-acre site (USGS 7-1/2' quad, Monterey; 36°37'20"N, 121°56'W) that contains the best known of the trees that support the swarms of monarch butterflies that winter at Monterey.

These natural areas have received no special legal status or protection to date, but are considered a resource of statewide critical concern by the State Office of Planning and Research.

Rare and Endangered Plants. Twenty-one rare and endangered plant species have been identified within the study area boundaries (see Table 12). Their general location has been identified on USGS topographic maps available at the California Native Plant Society office, Davis, California, or at Jones & Stokes Associates, Inc., Sacramento, California. Those species included on the U. S. Department of Interior's proposed list of endangered vascular plants are identified on Table 12.

In some cases, plant identification has been based on pre-1945 specimens and localities. Locations have been verified in many cases; however, changes in land use since 1945 may have affected distribution and occurrence of some species.

Some of these plants, such as Eastwood's ericameria and Santa Cruz and Hickman's cinquefoil, appear to be in imminent danger of extinction, while others, such as the Tidestrom lupine, Pacific Grove clover, Monterey clover, gowen cypress, and Monterey cypress appear to be stabilizing or increasing in numbers. Other plants appear to be declining in vigor and are endangered in at least part of their range. All 21 plant species are endemic to (occurring only in) California.

Many of the rare and endangered plants found in the Monterey Peninsula are located on private and public lands where they are protected against development and human encroachment.

Wildlife. Because of the diversity of plant life and the variety of habitats found in the study area, a wide variety of animal life exists. A habitat is the place where an animal or plant normally lives. Each habitat (ocean coast, salt marsh, freshwater marsh, grassland, chaparral, woodland and forest) supports various wildlife species. Some species are restricted to one habitat, while others are found in several habitats. (Common wildlife species of the study area are listed in Appendix H.)

Along the ocean coast, birds are the most evident form of animal life. Gulls, terns, murres, cormorants, pelicans and shore birds are common. The lack of significant shallow coastal areas keeps offshore bird population densities down and restricts use by bottom feeding waterfowl, however. Marine mammals, such as the southern sea otter and stellar sea lion, are often seen in Monterey Bay. The breakwater at

Table 12

VERY RARE AND RARE AND ENDANGERED PLANTS FOUND IN THE STUDY AREA

		Rarity Code*					
Common Name	Scientific Name	R	E	V	D	Habitat & Plant Community	General Location in Study Area
✓ Hickman's onion	*Allium hickmanii*	2	2	1	3	Grassy places, closed-cone pine forest	Monterey peninsula
Monterey manzanita	*Arctostaphylos montereyensis*	2	1	1	3	Sand dunes and woods, closed-cone pine forest	Near Seaside and south of Spreckels
✓ Sandmat manzanita	*A. pumila*	2	2	2	3	Sand hills and woods, coastal shrub and closed-cone pine forest	Near Seaside, Monterey peninsula, west of Marina
Monterey ceanothus	*Ceanothus rigidus*	2	2	1	3	Sandy hills and flats, coastal shrub and closed-cone pine forest	Near Prunedale, Marina, Seaside, Monterey peninsula and south of Spreckels
Seaside bird's-beak	*Cordylanthus littoralis* ssp. *littoralis*	3	2	1	3	Coastal strand and closed-cone pine forest	Near Salinas, Seaside, Moss Landing and west of Marina
✓ Gowen cypress	*Cupressus goveniana*	3	1	1	3	Dry slopes, closed-cone pine forest	Monterey peninsula
Monterey cypress	*C. macrocarpa*	3	1	1	3	Exposed headlands and dry places, closed-cone pine forest	Monterey peninsula
Hutchinson's delphinium	*Delphinium hutchinsonae*	2	2	1	3		Monterey peninsula and south of Spreckels
Pinnacles buckwheat	*Eriogonum nortonii*	2	2	1	3	Dry rocky slopes, chaparral	Near Fremont Peak, Gabilan Mountains
Temblor buckwheat	*E. temblorense*	2	1	1	3		West of Marina
Coast wallflower	*Erysimum ammophilum*	1	2	1	3	Coastal strand	West of Marina
Menzies wallflower	*E. menziesii*	2	2	2	3	Sand dunes, coastal strand	Monterey peninsula
✓ Eastwood's ericameria	*Haplopappus eastwoodiae*	2	3	3	3	Coastal sand dunes, coastal strand	Near Seaside, Monterey peninsula and west of Marina
✓ Santa Cruz tarweed	*Holocarpha macradenia*	3	2	2	3	Heavy soils and grassy flats, coastal shrub	Near Prunedale
✓ Tidestrom lupine	*Lupinus tidestromii* var. *tidestromii*	3	3	1	3	Coastal strand	Monterey peninsula
✓ Carmel Valley bush-mallow	*Malacothamnus palmeri* var. *involucratus*	2	2	1	3	Dry rocky slopes, chaparral	South of Spreckels
Gairdner's yampah	*Perideridia gairdneri* ssp. *gairdneri*	2	2	2	3		Monterey peninsula
✓ Hickman's cinquefoil	*Potentilla hickmanii*	3	3	2	3	Freshwater marsh	Monterey peninsula
✓ Monterey knotweed	*Polygonum montereyense*	PE			3	Dry-hard clay	Monterey peninsula
✓ Pacific Grove clover	*Trifolium polyodon*	3	3	1	3	Closed-cone pine forest	Monterey peninsula
✓ Monterey clover	*T. trichocalyx*	3	3	1	3	Sandy places, closed-cone pine forest	Monterey peninsula

* DEFINITION OF STATUS CODES:

Rarity (R)
1. Rare, of limited distribution, but distributed widely enough that potential for extinction or extirpation is apparently low at present.
2. Occurrence confined to several populations or one extended population.
3. Occurs in such small numbers that it is seldom reported; or occurs in one or very few highly restricted populations.

PE Possibly extinct or extirpated.

Endangerment (E)
1. Not endangered.
2. Endangered in part.
3. Totally endangered.

Vigor or Population Trend (V)
1. Stable or increasing.
2. Declining.
3. Approaching extinction or extirpation.

General Distribution (D)
1. Not rare outside California.
2. Rare outside California.
3. Endemic to California.

✓ Species included in the U. S. Department of Interior's proposed endangered vascular plants list (Federal Register, Vol. 41, No. 117, June 16, 1976).

Sources: California Native Plant Society, 1974; Munz and Keck, 1959; and Munz, 1968.

Monterey Harbor attracts a herd of 50 or more sea lions every year; this is one of the largest concentrations in the Monterey Bay area. Sea otters are also found in the harbor, but the main population is located further south along the coast. Smaller mammals such as blacktailed jack rabbits, brush rabbits, microtine mice, and kangaroo rats are also present. Invertebrate species and other marine life are discussed in more detail in the Monterey Bay Environment section.

Salt marsh habitats are important wildlife areas. Here, too, bird life is conspicuous. During the height of the bird migratory period (early fall to early spring), hundreds of shore birds, wading birds, marsh birds, waterfowl, predatory birds, and ocean-dwelling birds are found in Elkhorn Slough. Over 90 species of birds have been observed in the area. Some species are resident, many are migratory. The California clapper rail, an endangered species, is a resident of Elkhorn Slough. The large, contiguous expanse of associated marsh makes Elkhorn Slough one of the most valuable wildlife areas along California's central coast. Accordingly, the California Department of Fish and Game, the California Coastal Commission and the U. S. Fish and Wildlife Service have all recommended it be permanently preserved as wildlife habitat.

Mammals are not abundant in the marsh but are common in the chaparral and woodland areas around the marsh fringes.

The salt marsh and lagoon at the mouth of the Salinas River is also a valuable wildlife area, but is somewhat smaller than Elkhorn Slough. The brown pelican, an endangered species, is a common visitor to the Salinas River lagoon. During a field investigation of the area (October 14, 1975), approximately 30 brown pelicans were observed as well as marsh hawks, white-tailed kite, Heermann's gull, western gull, ring-necked pheasant, mourning dove, ruddy duck, American coot, horned grebe, sanderling, plover and willet. Habitat for the clapper rail, an endangered species found in Elkhorn Slough, is also present in the salt marsh at the mouth of the Salinas River, but the clapper rail has not been observed there. This marsh, the surrounding sand dunes, and upland areas are part of a California Department of Fish and Game Wildlife Area.

Freshwater marsh habitat is also valuable for wildlife. Small marsh areas provide drinking water for birds and mammals as well as nesting and cover habitat for many other wildlife species. Commonly observed marsh birds are blackbirds, wrens, wading birds, waterfowl, mud hens, and numerous song birds. Mammals present include raccoon, opossum, and brush rabbits. Amphibians and reptiles are represented by snakes, frogs, newts and salamanders.

Oak woodland and grassland habitat is widespread throughout the study area. Grasslands are important foraging areas for many forms of wildlife. Predatory birds such as hawks, owls and falcons are often seen in grassland areas. Other commonly observed birds are meadowlark, robin, sparrow, mourning dove and horned lark. Mammals include predatory coyote and fox, as well as jackrabbits, mice, gophers, ground squirrel and wild boar.

Oak woodland is often associated with grassland and brush areas. Some woodland is open with a grass understory, while other areas are intermixed with brush and shrubs. The oak trees provide food and shelter for many species of wildlife. Acorns (oak mast) are important food for black-tail deer, gray squirrels and various bird species. The trees also provide nesting cover for some birds.

Chaparral habitat, which occurs predominantly on the western slopes of the Gabilan Range, supports a moderately high black-tail deer population. For the county as a whole, deer densities in chaparral are estimated to be 10-30 animals per square mile. In oak-grassland, which provides the best deer habitat in the county, densities are estimated to be 30-60 animals per square mile (California Department of Fish and Game, 1965). Brush rabbit, coyote, fox, mountain lion, ground squirrel, and various mice are also abundant in the chaparral areas. Bird life includes wrens, sparrows, towhees, bushtit, valley quail, mourning dove and turkey vulture.

The small amount of pine forest habitat on the Monterey Peninsula supports many bird species including nuthatch, creeper, Steller's jay, waxwings and other song birds. Gray squirrels and black-tailed deer are mammals found in the pine forest. The close proximity of urbanization and limited extent of the habitat type have restricted its value for wildlife.

Riparian woodland is one of the most valuable wildlife habitat types because of its intermixed tall trees, brush and herbaceous vegetation and the close proximity of water. The Salinas River is the most extensive section of riparian woodland in the study area. The shrubs provide ground cover for song birds, quail, dove and small mammals such as rabbits, hares, mice, ground squirrels, coyote, fox and deer. The larger trees, including those that are dead or dying, provide nesting spots for many birds (hawks, owls, woodpecker, etc.) and gray squirrels. Riparian habitat bird populations and species diversity are second only to those of the study area's salt marshes.

Rare, Endangered and Threatened Wildlife. There are ten species of wildlife that are considered rare, endangered or threatened whose range includes (or may include) the study area. These species are listed in Table 13.

According to the California Department of Fish and Game (1974), a species which is considered "endangered" is one whose prospect for survival and reproduction is in immediate jeopardy. Its peril may result from one or many causes -- loss or change in habitat, overexploitation, *predation*, competition, or disease. Without help and protection, an endangered species would probably become extinct. A "rare" species is one that, although not presently threatened with extinction, exists in such small numbers throughout its range that it may become endangered if its numbers are further reduced, its range reduced or its habitat destroyed. The federal definition of endangered species is "those species in danger of extinction throughout all or a significant portion of their range"; threatened species include "those species which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range" (The Endangered Species Act of 1973, PL 93-205; 87 Stat. 884). Endangered species are so designated by being listed in the Federal Register.

The California least tern, California clapper rail and California brown pelican are known to occur around Elkhorn Slough. The California clapper rail is a resident of the Elkhorn Slough (Browning, et.al., 1972) and may occur in the Salinas River lagoon. The brown pelican and least tern are both migrant species found in the area in summer months. Brown pelicans are often observed on salt ponds along the north side of Elkhorn Slough and in the Salinas River lagoon.

The California yellow-billed cuckoo, once found throughout California in riparian habitat, is now rare. This species may be present in riparian habitat along the Salinas River.

The American peregrine falcon and southern bald eagle are transient species and could occur in the study area during the winter months.

The southern sea otter (Enhydra lutris), although not presently included on state rare or endangered species lists, was recently listed as a threatened species by the U. S. Fish and Wildlife Service (January 10, 1977, Federal Register). The otter is commonly observed in Monterey Bay, often near the wharf area. The main otter population is centered south of the study area below Carmel. However, the population is expanding and animals are moving north and south along the coast, reoccupying much of their former range.

Table 13

RARE, ENDANGERED AND THREATENED WILDLIFE SPECIES

Common Name	Scientific Name	Status	Study Area Distribution and Habitat
		Insects	
Smith's blue	Shijimiaeoides enoptes smithi	E*	Coastal sand dunes from Seaside to Marina.
		Amphibians	
Santa Cruz long-toed salamander	Ambystoma macrododactylum croceum	E, T	Occurs in Monterey County north of Moss Landing. Habitat is vernal pools and oak and willow thickets. May occur in freshwater ponds in the Monterey-Marina coastal strip.
		Birds	
American peregrine falcon	Falco peregrinus anatum	E, T	Breeds in California along coast.
Southern bald eagle	Haliaeetus leucocephalus l.	E, T	Occurs statewide.
California brown pelican	Pelecanus occidentalis californicus	E, T	Occurs along California coast from August through November.
California least tern	Sterna albifrons browni	E, T	Summer visitor from April through September along California coast. Occurs in Elkhorn Slough.
California clapper rail	Rallus longirostris obsoletus	E, T	Resident of salt marshes, including Elkhorn Slough.
California black rail	Laterallus jamaicensis coturniculus	R, T	Historically occurred in salt marshes from Tomales Bay south to lower California. May be present in Elkhorn Slough.
California yellow-billed cuckoo	Coccyzus americanus occidentalis	R	Historically occurred throughout California. May be present in riparian habitat along the Salinas River.
		Mammals	
Southern sea otter	Enhydra lutris	T	California population centered in Monterey County, primarily from Carmel River to Pt. Sur; not considered rare or endangered by California Department of Fish and Game.

R Rare)
E Endangered) designation by California Department of Fish and Game.
T Threatened)
E* Endangered) designation by U. S. Fish and Wildlife Service (endangered species have been officially listed in the Federal Register.)

The Santa Cruz long-toed salamander is known to occur at two locations in southern Santa Cruz County and two locations in northern Monterey County. The status of the Monterey populations is not well established, but the salamander has been observed in both McClusky and Bennett Sloughs (north of Elkhorn Slough). Several ponds along the coast between Monterey and the Salinas River have been identified as potential salamander habitat, but to date populations have not been located in these areas.

The Smith's blue is a small butterfly that occupies the most coastal portions of the sand dunes stretching from Seaside to Marina. Encroachment by urbanization, highway construction and the introduced ice plant (*Mesembryanthemum* spp.) has nearly eliminated its habitats, especially in the Marina area (Federal Register, Vol. 41, No. 106, Tuesday, June 1, 1976).

Fish. Most fish habitat in the study area occurs in the lower portion of the Salinas River, a few scattered farm ponds, and the upper reaches of several streams in the Gabilan Range. At the turn of the century, the Salinas River supported a large salmon and steelhead population. However, overharvesting, reduction of river flow and destruction of spawning areas have eliminated the salmon population and significantly reduced the steelhead population. The reduction in river flows is the direct result of man's diversion and storing of normal runoff for agricultural, industrial and domestic use. Nacimiento and San Antonio Dams are the most recent storage structures, but agricultural withdrawals reduced flows in the lower river long before construction of the dams. Spawning areas have been destroyed by gravel extraction and the lack of spring flows in sufficient quantity to wash silts and sands from the gravel bars. The present Salinas River fishing resource is confined to the lower river in the vicinity of the Salinas River lagoon. This area is subject to tidal action during the fall, winter and spring months when the sand bar blocking the mouth of the river is removed. Some seawater intrusion through the sand bar and into the Salinas River lagoon occurs during the summer months.

Both freshwater and salt water fish have been found in the Salinas River lagoon (Table H-3). Sturgeon, flounder, top smelt, shiner perch, pipefish and striped bass are marine and *euryhaline* species that move into the lagoon once it is opened to the ocean. These fish may move freely between the ocean and the lagoon while the mouth is open; however, during the summer months a sand bar blocks the mouth of the Salinas River, preventing fish movement. Some of these fish, especially the starry flounder and striped bass, may spawn in the lagoon.

Steelhead trout, once abundant in the Salinas River, now migrate in limited numbers up the river to spawn in small tributary streams over 150 miles from Salinas. Adult steelhead probably enter the river in late fall and winter after the sand bar blocking the river has been removed. Young steelhead remain in the home stream for about a year and descend the river to the ocean in the following spring or fall. Low or absent river flows in the spring and summer could hinder downstream migration of young steelhead.

Striped bass, important game fish throughout the state, occur in the lower Salinas River where there is a minor amount of sport fishing below the Highway 1 Bridge.

The Sacramento hitch, blackfish and squawfish (non-game species) are native to the Salinas River system. Carp, sunfishes (bluegill, green-eared sunfish, black bass and crappie) and catfishes are all introduced warmwater species. The sunfishes and catfishes were introduced to the area in the late 19th century and are now valuable and much sought-after game fish. The present population status of the sunfishes and catfishes in the lower Salinas River is unknown.

The species composition and abundance of the benthic community in the Salinas River lagoon is undocumented. The species present are, for at least part of the year, probably similar to those found in Elkhorn Slough. A baseline study of Moss Landing Harbor/Elkhorn Slough (Nybakken, Cailliet and Broenkow, 1975) found that its benthic community was dominated by three classes, Polychaeta, Mollusca and Crustacea. Capitellids and spinoids comprised the largest part of the polychaete fraction, while certain amphipods and tanaidaceae were the most common crustaceans. Almost all of the molluscs found in the slough were bivalves. The degree of benthic similarity between Elkhorn Slough and the Salinas River lagoon is entirely speculative, however. The entrance to Moss Landing Harbor is always open to the ocean; therefore, Elkhorn Slough is constantly influenced by the tides. The lower Salinas River is often shut off from the sea by a sand bar. A literature survey and personal communication found no reference to benthic studies in the Salinas River lagoon.

Existing Cultural Environment

Population

Existing population and future population trends relating to age, income and household organization are important in planning wastewater facilities.

TABLE 14

Historical Population in the Study Area & Its Region, 1930-1970

	1930	1940	1950	1960	1970	% Increase 1930-1970
Monterey County, Total	53,700	73,000	130,500	198,400	250,100	365
inside study area*	40,000	51,200	91,000	150,500	187,200	370
outside study area	13,700	21,800	39,500	47,900	62,900	360
San Benito County	11,300	11,400	14,400	15,400	18,200	60
Santa Cruz County	37,400	45,100	66,500	84,200	123,800	230
Regional Total	102,400	129,500	211,400	298,000	392,100	280

*Allocation of Monterey County total to areas inside and outside study area in 1930, 1940 and 1950 is approximate.

Source: U.S. Census, 1930-1970

TABLE 15

Change in Population of Incorporated and Unincorporated Areas in the Study Area, 1950-1975

	1950	1960	1970	1975	% Change, 1950-1975
Del Rey Oaks	uninc.	1,831	1,823	1,760	---
Marina	uninc.	uninc.	uninc.	11,950	---
Monterey	16,205	22,618	26,302	29,250	+80
Pacific Grove	9,623	12,121	13,505	16,800	+75
Salinas	13,917	28,957	58,896	68,600	+393
Sand City	uninc.	uninc.	212	210	---
Seaside	uninc.	19,353	35,935	33,950	---
Uninc. Areas	51,255	65,620	50,527	29,980	-42
TOTAL	91,000	150,500	187,200	192,500	+112
Uninc. Areas as Percent of Total	56%	44%	27%	16%	

Source: U.S. Census, 1950-1970; Calif. Dept. of Finance estimate, 1975.

Population in the Monterey Peninsula and the lower Salinas Valley has increased substantially in recent years. Three-fourths of Monterey County residents live in the study area. Monterey County has grown considerably more than neighboring counties over the past 40 years (see Table 14).

Table 15 illustrates a decline of population in unincorporated areas and the trend to urbanization. Though there are exceptions, there has been a decline in the proportion of the population under 18 and a rise in the proportion over 65 (see Table J-1). Figures also suggest a larger number of young adults. These changes are reflected in the number of households, which are increasing relatively faster than the population: widows and widowers often represent a single-person household. Lower fertility rates and the tendency of young women to marry later have also made the average household size drop. In 1960, Monterey County had 3.24 persons per household; in 1970, 3.11. In the City of Monterey, average household size fell from 3.03 to 2.72 persons. Ft. Ord expects occupancy of 2.2 persons per unit in its projected 1,000 units. Operation as a divisional headquarters will require more off-base housing. (Forecasts of military populations are, of course, subject to rapid change.) Since more housing units are needed to house these smaller families, public facilities planning is affected.

Such planning must also consider median income, since the affluence of the population is related to its capacity for public expenditure. The study area's median income figures are lower than those of the state as a whole, though they do reflect a rising trend typical of the urbanization taking place (Table J-2).

Population Projections

Growth within the study area is expected to be 60 to 80 percent between 1970 and 1995, a net gain of about 148,000 people (based on local government 1995 projections). Many factors tending to accelerate growth or restrain growth are considered in such projections. The State Department of Finance (DOF) regularly prepares and updates county forecasts, and the State Water Resources Control Board (SWRCB) adapts them to its jurisdictions. This forecast is presented (Table 16 and Figure 27) with two others, those of local jurisdictions in the Monterey Peninsula Water Pollution Control Agency and the Monterey County Transportation Study (MCTS). Possible double counting problems (anticipating annexations) may have inflated the local forecast total. The MCTS figures do not involve double counting and are considered more accurate by local planners.

Table 16

POPULATION FORECASTS FOR STUDY AREA

	AMBAG[1] Planning Area	1970 Census[2]	SWRCB Allocation of DOF 1995 D-100 Projection[3]	MCTS 1995 Projection[4]	Most Recent 1995 Projection by Local Jurisdictions[5]
Castroville	32,33	9,342	21,556	25,000	29,000
Marina	34	9,770	15,724	22,500	19,650
Fort Ord	35	31,128	42,201	30,400[8]	22,500
Monterey-Salinas	36	1,202	1,486	12,600	18,300
Salinas South, San Juan and Gabilan	37,38,39	8,103	21,464	10,990	29,500
Salinas	40	61,969	103,361	109,000	107,650
Toro	41	3,858	13,129	12,150	22,100
Seaside Sanitary District	42	22,200	23,115	29,000[6]	34,550
Monterey	43	26,329	35,764	33,300[7]	33,300
Pacific Grove	44	16,705	26,341	22,100	21,750
TOTAL		190,606	304,141	207,040	338,300

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[1] Association of Monterey Bay Area Governments; boundaries are approximate.

[2] Allocated to sanitary service area by Engineering Science, Inc. and tabulated in Engineering Science, Inc., 1975. Page II-41.

[3] Interpolated from State Water Resources Control Board data in Engineering Science, Inc., 1975.

[4] Monterey County Transportation Study, 1973a. The differences between MCTS and SWRCB figures appear to arise from boundary differences. The differences between MCTS and local forecasts appear to arise from double-counting; that is, areas likely to be annexed to incorporated cities between now and 1995 may have been counted in the local totals of both cities and unincorporated areas.

[5] Calculated from data supplied by William Maddaus, Engineering Science, Inc., pers. comm.

[6] Includes Seaside and Sand City.

[7] Includes Del Rey Oaks (2300).

[8] 15,000 added to original MCTS forecast, based on personal communication with MCTS staff.

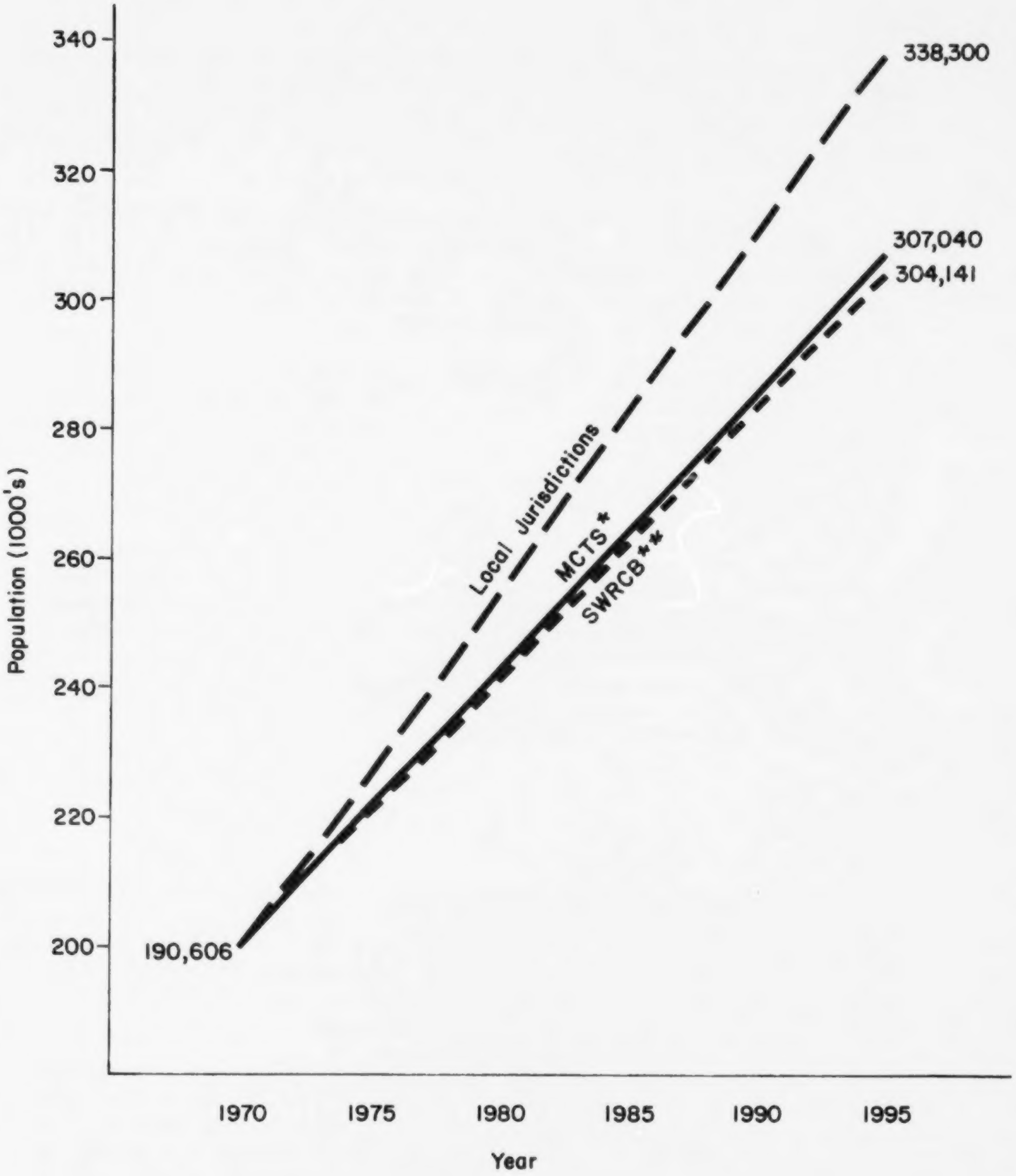

FIGURE 27 STUDY AREA POPULATION FORECASTS

* Monterey County Transportation Study.
** California State Water Resources Control Board.

Source: Table 16.

The military population is included in the SWRCB forecast, but was not included in the original MCTS forecast; the MCTS says the future Ft. Ord population which should be added to its total is 15,000 making the MCTS total 307,040, very close to the SWRCB's 304,141.

Different boundary lines selected by the SWRCB and the MCTS account for the variation in their figures for individual communities. Differences in forecasts which still remain when project facilities planning is finished will be discussed in the impacts section of this report.

Neither the state nor the local population projections have been modified to account for possible resource constraints (i.e., water shortages, energy shortages) or increased government control of growth (i.e., restrictions on provision of new public services for air and water quality maintenance or financial reasons; restriction of development in agricultural areas). Any of these factors could at some time in the future influence the course of population growth in the study area, but neither the likelihood nor the impact of these constraints can be determined at present. The water supply shortage on the Monterey Peninsula is already affecting growth rates in that area, but the duration and ultimate effect of the shortage is not known. If similar restraints continue to operate within the study area, actual population may turn out to be somewhat less than projected population.

Economics

Types of Economic Activities. The economic life of the region is dominated by agriculture, especially in the lower Salinas Valley, and by tourism, especially on the Monterey Peninsula. A third significant source of income from outside the region is the presence of a number of military establishments, of which Ft. Ord is the largest.

The importance of agriculture in the region's economy was discussed in the section on Land Use. Table J-6 presents data on the value of major crops in the lower Salinas Valley. In constant 1975 dollars, the value of those crops almost tripled between 1950 and 1975. This source of income is also important to those in agriculture-related industries (such as food processing) and to still others in retail and service occupations who provide goods and services for agricultural workers. Figures suggest that agricultural expansion in the county has not yet leveled out, and continued growth is possible.

The Monterey Peninsula Chamber of Commerce estimated 1973 revenues from tourism to be over $160 million. Most tourist expenditures are made not inland but on the peninsula, principally in Monterey, and, outside the study area, Carmel. According to State Board of Equalization figures, per capita sales at eating and drinking establishments in Monterey were $574.02 in 1970, compared to a state average of only $213.62.

Fort Ord, the area's largest military installation, had a 1972 payroll of $150 million. The total military payroll was over $154 million. The same year, the Department of Fish and Game estimated the value of commercial fish landings at the Port of Monterey as about $1.6 million (Engineering Science, Inc., 1975).

Employment. Changes in employment reflect changes in the regional economy. Table 17 presents state data on employment by industry over the years since 1950. (Reporting methods undercount agricultural employment, and undercounted government workers until 1958. Carmel, outside the study area, was included in the study.)

These figures reflect general employment categories of the region, and show that there has been an employment increase of about 140 percent in twenty years' time. The finance, insurance, and real estate sector as well as the service sector grew slightly faster than the total; manufacturing grew at the same rate as the total; government employment since 1960 has almost doubled; other sectors lagged behind.

It should be remembered that growth in such categories as transportation, communication, and utilities is likely to be related to agriculture, a basic activity of the region. Service employment is related to tourism, the other prominent regional industry.

Civilian employment in Salinas-Monterey-Carmel area in 1970 was estimated at about 68,000 persons (Table 17). Total employment in Monterey County was reported at near 100,000 (U. S. Census) in 1970.

As might be expected from the nature of regional occupations, 96 percent of Monterey County jobs are held by county residents (U. S. Census). Of Monterey County's out-commuters, more work in Santa Cruz County (37 percent) than anywhere else. Of in-commuters to Monterey County, more live in Santa Cruz County (45 percent) than live in any other county.

TABLE 17

Employment in the Study Area and the Central Coastal Region, 1970 and Projected 1995

	1970	1995	
Industry Sector	Study Area	Study Area	Central Coastal Basin
Trade	17,600	18,650	109,900
Services	15,500	22,150	210,950
Government	14,800	24,900	65,700
Agriculture, Forestry & Fisheries	3,400	other non-retail 44,950	22,700
Mining	100		2,200
Construction	3,200		23,800
Manufacturing	7,000		78,400
Transportation, Communication & Utilities	3,300		33,750
Finance, Insurance & Real Estate	2,900		29,550
Total	67,800	110,650	576,950
Column Number	1	2	3

Sources: Column 1, State of California as cited in Table J-3, p. 97; Column 2, Monterey County Transportation Study, 1973a; Column 3, Central Coastal Basin Plan cited in. Engineering-Science, Inc., 1975 (1995 figures interpolated from 1990 and 2000)

Employment Forecasts. Employment forecasts for 1995 are found in the Monterey County Transportation Study (1973a, Table 17). This forecast predicts a gradual decline in agricultural employment and stable mining employment. Military employment is expected to remain stable, and government employment to rise about 25 percent by 1995. Employment in all other industry groups is forecast to double except for services, in which employment is expected to quadruple by 1995. This reflects the view that recreation-oriented and tourist activity in the area will represent an even larger share of the region's economic activity in the future than it does at present.

Public Services and Facilities

Water Supply. The principal demand for water in the study area is for agriculture. Table 18 shows present and future agricultural water demands, and Table 19 urban requirements. In 1970 agricultural demand was 3.8 times domestic and industrial water use. In spite of the large demand, reclaimed water is not now used for crop irrigation.

The majority of the area's water supply is drawn from groundwater. In the Salinas Valley, domestic, industrial and agricultural water is pumped from underground aquifers, either by individual wells or community well fields. Nacimiento and San Antonio Dams, operated in the upper Salinas River watershed by the Monterey County Flood Control and Water Conservation District, are used to regulate runoff into the Salinas River so that as much water as possible percolates to the groundwater. This groundwater recharge program essentially acts as the supply system to the valley's wells. Increases in pumping for both agriculture and urban use have seriously overdrafted the groundwater supply in recent years. This is discussed in more detail in the Introduction and Water Resources sections of the report.

The Cities of Monterey, Pacific Grove, Del Rey Oaks, Sand City and Seaside are supplied by the California American Water Company (CAL-AM), which taps both surface and groundwater. Surface water is taken from the Carmel River at San Clemente and Los Padres Dams. Groundwater is pumped from both the Carmel River Valley and an aquifer below Seaside.

In recent years groundwater withdrawals from the Seaside aquifer have been suspected of causing salt water intrusion. As a result, the California Public Utilities Commission (PUC) has ordered CAL-AM to reduce its pumping in the Seaside area to 2,000 acre-feet/year. This cutback in available water supply has resulted in a ban on new hookups in the entire CAL-AM service area initiated by the PUC.

Table 18

AGRICULTURAL IRRIGATED ACREAGE AND TOTAL WATER DEMAND PROJECTIONS

Year	Irrigated Land (acres)	Irrigated Crops* (acres)	Annual Water Demand (acre-feet)
1970	42,000	56,500	133,100
1975	41,500	60,500	142,200
1985	40,500	68,000	159,700
1995	40,000	72,500	169,900

* Larger than irrigated land due to multiple cropping on same acreage.

Source: Adapted from Task Reports II-2 and II-3 AMBAG Plan (Yoder-Trotter-Orlob & Associates, 1973).

Table 19

URBAN WATER DEMANDS BY PLANNING AREA (acre-feet/year)*

Planning Area	Unit Water Use - Gallons/ Capita/Day**	1970	1975	1985	1995
32 Castroville	145	990	1,200	1,800	2,760
33 Castroville S.D.[1]	545	1,970	2,380	3,660	5,250
34 Marina[1]	125	1,370	1,540	1,920	2,280
35 Fort Ord[1]	175	6,300	6,660	7,450	8,330
36 Monterey-Salinas Highway	160	220	220	250	250
37 Salinas South	180	210	280	260	260
38 San Juan	180	1,280	2,180	3,100	4,330
39 Gabilan	180	140	160	200	290
40 Salinas[1]	180	12,490	13,510	16,990	21,310
41 Toro	180	780	1,050	1,920	3,430
42 Seaside S.D.[1]	95	2,360	2,400	2,210	2,440
43 Monterey[1]	160	4,720	5,110	5,660	6,200
44 Pacific Grove[1]	115	2,150	2,340	2,680	3,000
Sewered Areas Total		31,360	33,940	40,570	48,810
Unsewered Areas Total		3,620	5,090	7,530	11,270
GRAND TOTAL		34,980	39,030	48,100	60,000

[1] Sewered area.

* Based on County Planning Department population projections.

** Calculated by Engineering Science, Inc., from information in Task Reports II-2 and II-3 AMBAG Plan (Yoder-Trotter-Orlob & Associates, 1973).

CAL-AM is currently working on a project to upgrade their well water treatment and increase their capacity to deliver water from the Carmel Valley to the Seaside-Monterey area. The increase in delivery capacity is designed to improve service to existing customers and provide service to additional customers within the existing service area. Transmission capacity is to be increased to 22,000 acre-feet/year (2,000 from Seaside aquifer, 11,000 from Carmel Valley aquifer and 9,000 from Los Padres and San Clemente Reservoirs), based on a PUC finding that this is the total water supply available to CAL-AM. However, there is considerable controversy over what should be considered the safe yield of the Carmel Valley aquifer, making total water supply availability open to question (California Public Utilities Commission, 1976). Estimates of how many years this project will extend water service to the area are therefore also open to question.

Ft. Ord, Marina and the remaining rural areas that are within the study area but outside the Salinas Valley or CAL-AM's service area also draw their water from groundwater stores. To date there has been no serious depletion of supplies in these areas, even though some of Ft. Ord's wells have been influenced by moderate salt water intrusion in the past. Ft. Ord is currently investigating the possibility of relocating their well field east of Fritzsche Air Field.

There have been several projects proposed to relieve the water shortages found on the Monterey Peninsula and the lower Salinas Valley. The CAL-AM groundwater withdrawal plans have already been mentioned. In addition, a large dam constructed by either CAL-AM or the U. S. Army Corps of Engineers on the Carmel River has been suggested as a new source of water. This is an extremely expensive long range plan and is not expected to be a factor in the next 5 to 10 years. A dam on the Arroyo Seco has also been suggested as a means to increase groundwater recharge of the Salinas Valley aquifers and supply water to high pumpage areas. This project is currently inactive. Two other surface diversion projects aimed at supplying water to high groundwater pumpage areas are also currently inactive. The Castroville Irrigation Project, designed to deliver water from the Salinas River near Salinas to the Castroville area for agricultural use, has been halted pending study of a possible 900-foot aquifer source in the valley's groundwater basin. The East Side Canal Project, designed to divert Salinas River water near Soledad and transport it to the East Side aquifer for groundwater recharge, has not advanced beyond the initial planning stage.

Other options being considered to augment local water supplies include tapping of possible deeper groundwater aquifers (the 900-foot aquifer mentioned above) and reclamation and reuse of domestic wastewater. State and federal water developments tapping the Sacramento-San Joaquin Valley basins have not yet included delivery to the Monterey-Salinas area in their plans.

Several water conservation measures have been enacted recently in the Monterey Peninsula area due to the severity of the 1975-1976 water year drought. The CAL-AM has imposed a water rationing program within its service area at the urging of the California Public Utilities Commission. The three-phase rationing plan places various degrees of control on the outside use of water, including landscape and golf course irrigation and washing of sidewalks, motor vehicles, trailers, boats, etc. The degree of restriction varies with the volume of water stored in CAL-AM reservoirs. The City of Monterey also adopted a modification to the city building code that requires installation of low-water-use toilets and shower heads and recirculating water systems in decorative fountains as a condition to receiving building permits for new structures. The City of Pacific Grove also adopted an ordinance placing restrictions on new water service connections and requiring low-water-use facilities in newly-constructed or substantially reconstructed dwellings or businesses.

The problems of water supply are also covered extensively in the Introduction to this report and in the Water Resources Section.

Liquid Waste Disposal. There are eight major wastewater treatment plants and several minor ones in the study area. They are maintained by the Castroville County Sanitation District, Marina County Water District, Seaside County Sanitation District, City of Salinas (3 facilities, including one for industrial waste), City of Monterey, City of Pacific Grove, and Ft. Ord, with one main facility and two small ones.

Process flow diagrams and design criteria for these plants are shown in the Facilities Plan (Engineering Science, Inc., 1976d).

Plant capacities and characteristics are discussed in the Introduction of this EIS. Table 20 shows wastewater flows and per capita generation, and Figure 2 shows wastewater discharge locations of the above facilities. The quality of the individual discharges is presented in Table K-2. Table 21 shows service area populations and connections.

Each of the major treatment plants is experiencing or will soon be experiencing problems meeting state and federal wastewater discharge requirements. A brief description of these shortcomings, taken from the Draft Facilities Plan, is presented below:

> Pacific Grove - the primary level treatment being used fails to meet RWQCB suspended solids discharge requirements; it also fails to meet the Federal Water Pollution Control Act, 1977, treatment requirements (this plant is being abandoned).

Table 20

1975 WASTEWATER FLOWS AND PER CAPITA GENERATION

Agency	1975 Average Annual Flow-mgd	Per Capita Flow Generation-gpcd
Castroville County Sanitation District	0.34	86
Marina County Water District	0.80	74.6
Seaside County Sanitation District	1.55	65.2
City of Salinas	8.2*	140**
City of Monterey	3.20	112
City of Pacific Grove	1.40	78.5
Ft. Ord (main garrison plant)	2.3	68.3

Table 21

CURRENT SERVICE AREA, POPULATION AND SERVICE CONNECTIONS CHARACTERISTICS 1974-75 [1]

Entity	Service Area (Acres)	Population	Sewer Connections	Equiv. Dwelling Units	Avg. Dry Weather Flow (mgd)
Monterey	5,102	28,150	6,411	11,066	3.20
Pacific Grove[2]	3,988	18,000	6,765	7,400	1.40
Salinas	9,088	69,500	21,500	23,670	8.20*
Castroville C.S.D.	463	3,800	800	1,118	0.34
Seaside C.S.D.	2,120	24,800	6,464	6,900	1.55
Marina C.W.D.	1,600	11,500	2,429	3,215	0.80
Total	22,361	155,750	44,369	53,369	15.49

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1 - Source: City and district records.

2 - Also includes Del Monte Park C.S.D.

Source: Engineering Science, Inc., 1975.

* Includes 4.8 from Salinas Main, 0.7 from Salinas Alisal and 2.8 from Salinas industrial.

** Influenced by industrial discharges.

Monterey - the secondary treatment effluent fails to meet the 1977 federal BOD and suspended solids requirements; the discharge location is also within a discharge prohibition zone established by the RWQCB.

Seaside County Sanitation District - the primary treatment system fails to provide effluent quality sufficient to meet 1977 federal requirements; the discharge is also within a Monterey Bay discharge prohibition zone.

Ft. Ord - the Ft. Ord main garrison plant currently discharges treated effluent to Indian Head Beach, creating a potential health hazard to adjacent beaches. A proposed spray irrigation system is opposed by the State Department of Health due to the potential groundwater contamination hazard. The discharge is within the bay RWQCB discharge prohibition zone.

Marina County Water District - the Marina treatment system provides a wastewater quality sufficient to meet existing and proposed discharge requirements, but the discharge is within the RWQCB prohibition zone.

Salinas Plant No. 1 (Main Plant) - the secondary plant's effluent quality meets current discharge standards, but expected flow increases will result in unacceptably high suspended solids levels. The existing effluent does not meet river discharge quality guidelines recommended in the area's Basin Plan (California State Water Resources Control Board, 1975a).

Salinas Plant No. 2 (Alisal Plant) - effluent quality from this secondary facility meets present requirements, but the discharge to the river does not meet quality guidelines recommended in the area's Basin Plan.

Castroville County Sanitation District - this recently modified secondary plant is expected to produce effluent of sufficient quality to meet current standards. In the past it has had trouble meeting the suspended solids requirement. The discharge to Tembladero Slough is not in compliance with water quality recommendations in the Basin Plan (Engineering Science, Inc., 1976d).

There are numerous private waste treatment facilities and individual septic tanks in rural areas (Tables J-7 and J-8). There are also two major industrial liquid waste discharges to Monterey Bay. These are the Kaiser and Pacific Gas and Electric outfalls at Moss Landing. The character of these discharges is discussed in the Monterey Bay Environment section.

The Salinas industrial wastewater treatment and disposal ponds on the bank of the Salinas River (Figure 14) have no direct discharge to surface waters. Industrial wastewater (average flow of 2.8 mgd in 1974) is piped to a series of aerated lagoons and then sprinkler irrigated and percolated to the groundwater. It is not known whether the percolated water resurfaces in the Salinas River downstream, but its high salt content is undoubtedly contributing in some degree to the poor quality of the surface aquifer in the area. The saline condition of this uppermost aquifer has all but eliminated its use for domestic or agricultural water supply. For economic reasons, the industrial wastewater system has not been included as part of the north Monterey County regional wastewater treatment proposal. Handling of the industrial flows in the existing manner is not expected to prevent attainment of water quality objectives.

Solid Waste Disposal. There are four solid waste disposal sites in or near the study area: Crazy Horse Canyon, Chualar, Marina, and Ft. Ord, which is not open to the public.

The sites meet most of the present needs of the study area, though hazardous wastes must be sent out of the area.

Monterey County's Solid Waste Management Plan (Munson, 1976) calls for closure of the Chualar site by January 1977 because it is in the Salinas River floodplain. Its waste flow would probably be diverted to the Marina and Crazy Horse Canyon sites. By 1990 the Crazy Horse Canyon and Ft. Ord sites will also be closed, consolidating waste flows into the Marina site. There will be an increased salvage effort at the Marina site. By 2000 an active methane gas recovery and mechanical glass and metal recovery system is expected to be in use at Marina (Munson, 1976).

If the Marina site maintains its existing size and service area, its expected life is estimated to be 70 years. If it becomes the only north Monterey County site as described above, it will probably increase its size and have an estimated life expectancy of 50 to 70 years (Munson, 1976).

TABLE 22

MUNICIPAL SOLID WASTE PROJECTIONS
(Tons/Year)

Service Area	1975	1980	1990	2000
Monterey Peninsula, Carmel Valley, Coast, Marina	120,000	135,000	157,000	172,000
North County	19,000	25,000	34,000	42,000
Salinas	90,000	108,000	130,000	145,000
Gabilan	219	246	274	300
Toro	2,810	5,670	11,500	22,970
TOTALS	232,029	273,916	332,774	382,270

Source: Munson, 1976.

Power. Pacific Gas and Electric Company supplies both electrical and natural gas power to the entire study area. The electricity comes through their Northern California grid system and cannot be traced to any one generation site, but the Moss Landing natural gas and fuel oil-fired plant is part of that grid. Natural gas is piped in from a main north-south header that passes through the Santa Clara Valley.

Transportation. State Routes 1 and 68 and U.S. Route 101 serve interregional as well as intercity traffic. County roads and State highways 156, 183 and 218 are minor arterials or collectors (see Figure 1). In the county there are 2,103 miles of roads and streets: 301 are state highways, 1,330 county roads, and the rest city streets. Parts of State Routes 1 and 68 are officially designated state scenic routes and others are planned. (see Amenities.)

Most trips are made by automobile. Less than one percent of all travel is on public transportation. Table J-10 lists miles of road and vehicle miles traveled for the major cities in the county. In 1974, 85 percent of all county households were estimated to have one car; 30 percent had two or more (Monterey County Transportation Study, 1973).

Monterey Peninsula Transit offers intra-regional service on the peninsula and between the peninsula and Salinas. Greyhound provides service on U. S. 101 and between Salinas and Pacific Grove.

There is limited rail passenger service (two AMTRAK stops daily in Salinas, on the Oakland/Los Angeles route) and heavy freight service. Of the nine freight points, Spreckels and Salinas handled 1.0 million tons and 0.9 million respectively in 1970 (Monterey County Transportation Study, 1973).

The only commercial air service in the county is at the Monterey Peninsula Airport in Monterey. In 1970 it averaged 400 landings daily. An airport at Salinas serves general aviation. The Fort Ord airport is base-oriented, with few flights to other points.

Schools, Police and Fire Protection. Government agencies providing local services include general purpose governments, which provide for the administration of government and services such as public safety, libraries, neighborhood and community parks, and so forth. Cities in the study area having their own police and fire departments are Pacific Grove, Monterey, Seaside and Salinas. The City of Marina expects to have its own police department by 1977; it already has a fire department. Sand City has a police department and contracts with Seaside for fire protection. Del Rey Oaks has a police department and contracts with Monterey for fire protection. All unincorporated areas receive police protection from the Monterey County Sheriff. Castroville has its own fire department, which also has a station serving Moss Landing. There are separate fire protection systems in operation at the Monterey Airport and at Ft. Ord.

Special purpose districts may be formed for a variety of public purposes: flood control, regional parks, public transportation, mosquito abatement, and so forth. Typically, the most important kind of special purpose district is the school district, which often accounts for the largest share of the local property tax dollar. There are eight school districts providing elementary and secondary education in the study area and two districts providing college-level education (Monterey Peninsula, with facilities in Monterey, and Hartnell Community, with facilities in Salinas).

The school districts' recent enrollment experience has varied by area. The largest district in terms of total enrollment (15,717 pupils in 1975-1976) is the Monterey Peninsula Unified School District, which serves kindergarten through high school. Enrollment has been in rapid decline in this district and two schools have been closed in the past two years. The decline in enrollment has been attributed to cut-backs at Ft. Ord and the high cost of living in Monterey (Clark, pers. comm.). Continued decline in enrollment is anticipated for the foreseeable future and more school shutdowns are expected. The smaller unified district in Pacific Grove (3,108 pupils) has also been experiencing a declining enrollment in recent years, though no closures are planned.

In Salinas, the Salinas City School District (6,200 pupils) also reports declining total enrollment in its 14 elementary schools. Above the elementary level, the Salinas Union High School District (8,675 pupils) reports stable junior high school enrollments and slowly increasing high school enrollments. Some schools in this district are presently overcrowded, but the pressure will be lessened by the 1978 opening of the new high school just east of Castroville, which will remove about 1,600 pupils from Salinas schools.

Districts reporting increasing enrollments are the North Monterey County Unified School District (3,178 pupils) serving Moss Landing, Prunedale and Castroville; and the Spreckels Union School District, serving the Spreckels area (609 pupils). The former district reports growing enrollments, particularly attributable to new development in the Prunedale area. The district will open a new high school in 1978, as mentioned above. The Spreckels District anticipates slowly rising growth due to subdivision activity, and will consider building a new school to increase district capacity by 300 to 500 as new development is approved. The Santa Rita Union School District (1,100) also reports increasing enrollments, which it attributes to new residential construction in the Northridge area. Finally, the Alisal District (2,302 pupils) sees slowly rising enrollments due to new construction and the Washington Union District (791) reports stable enrollment.

History

Indian Period. At the time of Spanish intrusion, the Rumsen dialectic branch of the Costanoan people, part of the Penutian language family, occupied the study area and beyond, from San Francisco Bay to near Point Sur and probably inland to the coast mountains. Major villages were usually on bays near fresh water, with smaller camps and villages for seasonal gathering both on the coast and inland. Displacement of the Indians began with the establishment of Spanish Missions.

Spanish Colonization. Cabrillo entered Monterey Bay in 1542, but heavy surf prevented his landing. The Monterey Bay area was mapped and surveyed in 1602 by Vizcaino, who was seeking a suitable harbor for the Spanish fleet. For the next 150 years, wars and internal problems prevented settlement, but the threatened encroachment of Russian fur traders spurred Charles III to send Gaspar de Portola to establish missions and presidios in Alta California.

In 1770, therefore, Portola and Father Junipero Serra claimed the area for the Spanish crown. Land expeditions from Mexico (the first led by de Anza) brought colonists. Monterey became the capital of California, and the religious capital as well, since it was in the middle of the chain of missions by then stretching from San Diego to north of San Francisco.

After the Mexican war of independence, California was governed by Mexico and Monterey lost its status as a capital.

American Annexation. In 1846 the United States, victorious in the Mexican-American war, acquired California and Monterey. In 1849 a constitutional convention was held in Monterey, the main issue being whether California was to be a state or a territory. The delegates voted to join the union as a free (as opposed to a slave) state.

The gold rush transferred Monterey's business and prestige to the port of San Francisco, more convenient to the gold fields, and the state capital became San Jose.

In the 1850's and 1860's, whaling was the major industry on the coast. In the 1900's sardine fishing replaced whaling; by 1920, Monterey had the third largest fish tonnage in the world. But by 1940 the catch had decreased drastically, forcing many companies out of business.

The City of Salinas was founded in 1856 as a resting place halfway between the Carmel and San Juan Bautista missions. By 1874, when the city was incorporated, it had become a commercial and agricultural center for a 3-county area. Today it remains an active agricultural community and is the seat of the Monterey County government.

Historic sites. Search of the *National Register of Historic Places* (*Federal Register*, *February 10, 1976, Vol. 41 No. 28 and Amendments to date*) and a listing of California historical landmarks (California Department of Parks and Recreation, 1971) determined that no recognized historic sites are found on or adjacent to facilities planned as part of this project. A list of state and federal sites found within the study area is presented below.

El Castillo - Monterey
Larkin House - Monterey
Monterey Old Town Historic District - Monterey
Royal Presidio Chapel - Monterey
Stevenson House - Monterey
U. S. Customhouse - Monterey
Boronda, Jose-Eusebio Adobe - Salinas
Colton Hall - Monterey
Vizcaino-Serra Landing - Monterey
First Theater - Monterey
Governor Alvarado House - Monterey
Vasquez House - Monterey
Stevenson House - Monterey
House of Four Winds - Monterey
Pacific House - Monterey
Casa de Oro - Monterey
Hill Town Ferry - between Monterey and Salinas
Chautauqua Hall - Pacific Grove
Gutierriz Adobe - Monterey
Soberanes Adobe - Monterey
Battle of Natividad - Natividad

The National Register of Historic Places is published in its entirety in the Federal Register during the month of February each year. Addenda are also published in the Federal Register the first Tuesday of each month to add newly-recognized sites.

Amenities

Visual. The scenery of the study area is famous. Some of the most beautiful coastline in California is seen on the peninsula's 17-mile drive. State Highway 68 from Monterey to Salinas, and State Highway 1 from its junction with 68 southward are officially designated state scenic routes. State Highway 1 north of the 68 junction and State Highway 156 from Castroville to Prunedale are on the Scenic Highways Master Plan, but not yet designated. Laureles Grade from Highway 68 to Carmel Valley Road is a county scenic route. A wide variety of visual experiences account for this abundance of designations -- the open, flat Salinas Valley flanked by steeply rising mountains; rolling, oak-covered hills; open woodland and grassland; sparsely vegetated sand dunes; interesting croplands; urban development more attractive than most; the historic and picturesque city of Monterey.

Recreation. The area's physical beauty is enhanced by its world famous golf courses - 15 in the county; most are inside or next to the study area.

The many parks are listed under Land Use. These are popular for swimming and other water sports, such as skin-diving. (Some divers fish for abalone.) Deep-sea fishing is available, as is waterfowl hunting. Pleasure boating is popular (see Land Use).

The City of Monterey has two particular attractions -- its well-maintained historical buildings, and the harbor. At the harbor, a breakwater visited by sea lions and birds offers a pleasant backdrop to the busy complex of restaurants and gift shops, many selling the books of John Steinbeck, whose novels made the area familiar around the world.

The major spectator events in the area include annual auto races at Laguna Seca (30,000-50,000 attendees), the Bing Crosby Golf Tournament in Pebble Beach, and the Monterey Jazz Festival (5,000-6,000 attendees). The wide range of attractions has made the study area a second home or retirement home choice of many, and such a tourist mecca that tourism is a major industry.

Site Specific Environment

This section of the environmental setting describes in greater detail those sites that may be physically modified by the proposed project. The description is limited to the site conditions that will be significantly affected by the proposed action or will significantly influence the magnitude of project impacts. Where proposed project facilities have not yet been located on a specific site, the general area likely to be impacted is described.

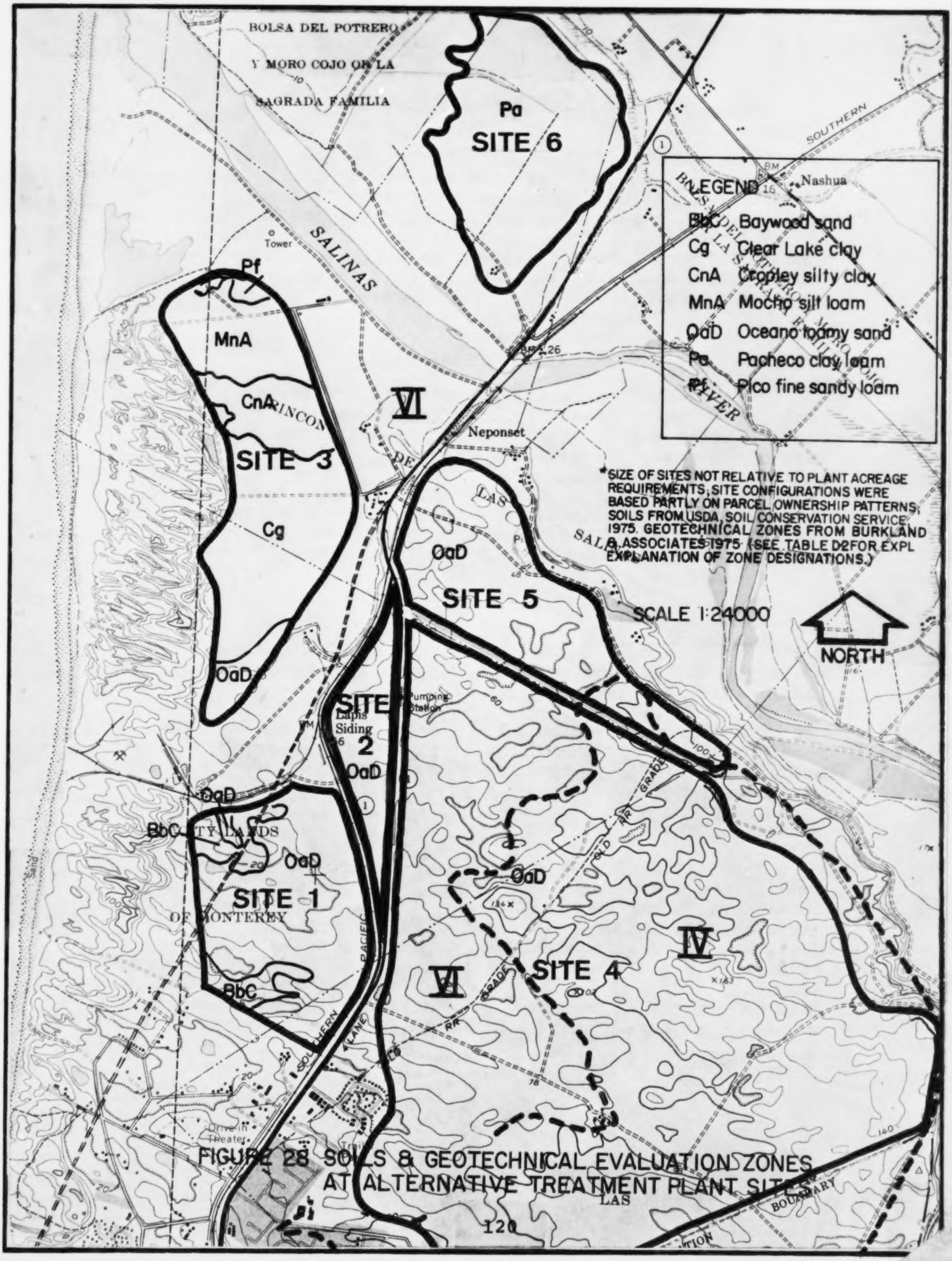
Potential Regional Treatment Plant Sites

Six alternative sites were originally considered for the regional treatment facility near the mouth of the Salinas River (Figure 28). Later, two additional sites on Ft. Ord were considered, but they are not given detailed coverage here for reasons stated in the Alternatives section. The reason for selection of all the sites is also described in the Alternatives section. The parcels are of varying sizes and all are considerably larger than the land needed for the plant. The most probable facility location within several of the sites is indicated in Figure 30.

Alternative Site 1. Regional treatment plant Site 1 is a 250+ acre parcel of low undulating, stabilized sand dunes (2-15 percent slopes) with both internal and external drainage. The site is privately owned.

The current land use of the site is grazing, and the vegetative cover is grassland. The new State Highway 1 route borders the property on the west and a sand mining operation is immediately northwest. The land to the north and east is also open grassland which is occasionally grazed. Urban development borders on the south.

The 1967 Marina Master Plan (Monterey County Planning Commission, 1967) designates Site 1 as industrial reserve in the future. Land immediately south is planned as single family residential and land to the east, across State Highway 1, is designated for urban expansion. The extreme southern portion of Site 1 is within the city limits of the recently incorporated city of Marina. The planning for that area may therefore be subject to change. Current zoning in the vicinity of all of the treatment plant sites is shown in Figure J-1.



*SIZE OF SITES NOT RELATIVE TO PLANT ACREAGE REQUIREMENTS, SITE CONFIGURATIONS WERE BASED PARTLY ON PARCEL OWNERSHIP PATTERNS, SOILS FROM USDA, SOIL CONSERVATION SERVICE 1975. GEOTECHNICAL ZONES FROM BURKLAND & ASSOCIATES 1975 (SEE TABLE D2 FOR EXPL EXPLANATION OF ZONE DESIGNATIONS.)

FIGURE 28 SOILS & GEOTECHNICAL EVALUATION ZONES AT ALTERNATIVE TREATMENT PLANT SITES

The California Coastal Plan, recently published by the California Coastal Zone Conservation Commission (1975), has designated Site 1 as grazing land. The area is also within a large special study zone, however. This indicates that the Coastal Commission recommends additional study to determine the ultimate use of the land. The coastal sand dunes to the west of Site 1 are listed as special land habitat in the plan, and are recommended for acquisition. The southwestern tip of Site 1 is within the Coastal Commission's permit zone.

Most of the site is overlooked by both the existing and the new State Highway 1 routes. The northern end of the property is blocked from view to those traveling south on the present Route 1. A field survey located no surface evidence of archeological resources.

Recent (stabilized) sand dune deposits underly the entire site. Oceano loamy sand and Baywood sand soils have formed on the surface. Figure 28 shows the distribution and Table 23 the properties and limitations of the soils in the vicinity of all of the treatment plant sites, as recorded in the *Soil Survey of Monterey County, California, An Interim, Unedited Report* (U. S. Department of Agriculture, Soil Conservation Service, 1975).

Faults in the vicinity of the alternative treatment plant sites are described in the Seismic Features section of the Environmental Setting.

Alternative Site 2. Treatment plant Site 2 is a 80+ acre plot of old sand dunes; it is relatively level and elevated slightly above adjacent Highway 1. Drainage is to the west and southwest. The entire site is privately owned.

The open land shows no sign of current human use. It does not appear to have been recently grazed, but its grasses may be occasionally mowed.

Alternative Site 1, described above, lies to the southwest of Site 2, while Site 4 is immediately across Highway 1 to the east. Rolling grassland also borders the property to the west and northeast. Row crops are being grown on the flat agricultural land to the northwest. There are no residences or structures of any kind on or immediately adjacent to Site 2.

The Marina Master Plan designates Site 2 as industrial reserve. Land to the west is similarly designated, while the land to the east across State Highway 1 is planned for urban expansion. The California Coastal Plan (California Coastal Zone Conservation Commission, 1975) designates Site 2 as grazing land, but also includes it within a special study area (see Site 1 above for explanation).

Table 23

SOILS MAPPED WITHIN PROPOSED TREATMENT PLANT SITES

Mapping Symbol	Soil Phase*	Depth In.	Rating for Use as Sewage Lagoon Area	Engineering Classification		Shrink-Swell Potential	Erosion Factors		Flooding	High Water Table Depth-Ft.	Rating as Construction Site for Small Commercial Building	Factors Adversely Affecting Water Management Features:	
				Unified	AASHO		K	T				Pond, Reservoir Area	Embankments, Levees
BbC	Baywood sand, 2-15% slopes	0-60	Severe: slope, seepage	SP-SM, SM	A-3, A-2	Low	0.15	5	None	>6.0	Severe: slope	Slope, seepage	Piping
Cg	Clear Lake clay, moderately wet	0-33 33-54 54-62	Severe: floods	CL,CH CL SM	A-7 A-6 A-4	High Moderate Low	0.24 0.24 0.24	5	Common-brief	3.0-5.0 Jan-Dec	Severe: floods, shrink-swell, low strength	Favorable	Low strength, piping, hard to pack
CnA	Cropley silty clay, 0-2% slopes	0-69	Slight	CL,CH	A-7	High	0.24	5	None	>6.0	Severe: shrink-swell, low strength	Favorable	Low strength, compressible, hard to pack
MnA	Mocho silt loam, 0-2% slopes	0-68	Moderate: seepage	CL-ML, CL	A-4 A-6	Moderate	0.43	5	None	>6.0	Moderate: shrink-swell	Seepage	Piping, hard to pack
OaD	Oceano loamy sand, 2-15% slopes	0-80	Severe: slope, seepage	SP-SM, SM	A-2 A-3	Low	0.10	5	None	>6.0	Severe: slope	Slope, seepage	Seepage, piping, hard to pack
Pa	Pacheco clay loam	0-65	Severe: wetness	CL	A-6, A-7	Moderate	0.43	5	None to rare	3.0-5.0 Dec-May	Moderate: shrink-swell, low strength	Favorable	Low strength
Pf	Pico fine sandy loam	0-55 55-72	Severe: seepage	SM SM	A-4 A-1, A-2	Low Low	0.20 0.10	5	None	>6.0	Slight	Seepage	Piping

* Soil terminology defined in the Glossary.

Source: U. S. Department of Agriculture, Soil Conservation Service, 1975.

Site 2 can be clearly viewed from the new route of State Highway 1 but is partially hidden to persons traveling the present highway by a low hill. An archeological field survey uncovered no archeological resources.

Geologically, the entire site is underlain by Recent sand dunes (stabilized); the soil is Oceano loamy sand (Figure 28). See the Alternative Site 1 section for a discussion of seismic hazards in the vicinity of Site 2 and the remaining sites.

Alternative Site 3. Treatment plant Site 3 includes 320 acres of level alluvial land immediately south of the Salinas River. The plot is less than 10 feet above sea level and drains northward into the river.

The major portion of the area is privately owned and currently being cultivated for production of row crops. The extreme north end, however, lies within a federally-owned wildlife area managed by the California Department of Fish and Game and is open to public use. Coastal sand dunes and the Pacific Ocean lie immediately west of the property while open grassland and additional agricultural acreage are to the south. Both the present and the new State Highway 1 routes run along the eastern border of the site. The state-managed wildlife area and the Salinas River adjoin the property to the north while several agricultural service roads and farm houses and more agricultural land lie to the northeast.

The major portion of the site is depicted as agricultural on the Marina Master Plan, but the extreme northern tip lies within a recreation area and the southern tip is within industrial reserve. Land immediately to the west is shown as multiple residential and the new State Highway 1 route is shown to the east on the Marina Master Plan. The new City of Marina abuts the southwestern edge of Site 3; planning for future use of that area may therefore change.

The California Coastal Plan (California Coastal Zone Conservation Commission, 1975) includes the site within a cultivated agriculture designation and the same special study zone referred to in the Site 1 and 2 descriptions. The dunes to the west are within a special land habitat and have been proposed for acquisition by the Coastal Commission. The western fringe of Site 3 is within the Commission's permit zone.

Site 3 is clearly visible from both the present and future routes of State Highway 1. There were no archeological resources found in a field survey of the area.

Recent Salinas River alluvial deposits underly most of Site 3, with only the extreme southern end extending into the stabilized sand dunes. Soils of the area include Clear Lake clay (moderately wet), Cropley silty clay, Mocho silt loam, Pico fine sandy loam and Oceano loamy sand (Figure 28).

Alternative Site 4. Site 4 is a 760-acre parcel of rolling dune land with elevations ranging from less than 60 to over 160 feet. Drainage is predominantly to the west. Treatment plant Sites 1 and 2 border the property on the west and Site 5 borders to the north. All of these sites are quite similar in appearance.

The current use of Site 4 is non-irrigated grazing and solid waste landfilling. Land to the west, across State Highway 1, and to the north, across the landfill access road, is also grazed. The Marina sanitary landfill is located in the northeastern portion of the site and the Salinas River floodplain runs along the entire eastern edge. The southern border is formed by the Ft. Ord Military Reservation boundary while the southeastern edge of Site 4 abuts the City of Marina's urban fringe. Ownership of Site 4 is divided between private individuals and the Monterey Peninsula Garbage and Refuse Disposal District.

The county's Marina Master Plan designates most of Site 4 for future urban expansion. The southwestern corner of the site is now within the City of Marina, however, and planning for the area may be altered as a result. The California Coastal Plan (California Coastal Zone Conservation Commission, 1975) lists Site 4 as grazing land.

Very little of Site 4 is visible from roads in the area. Rolling hills along the western border block views from Highway 1. There were no archeological resources found in a field survey of the area.

Recent sand dunes (stabilized) underly all of Site 4. Oceano loamy sand soils have formed on the surface.

Alternative Site 5. Treatment plant Site 5, immediately north of Site 4, is underlain by the same old sand dune formation as Sites 1, 2 and 4. Elevations range from slightly less than 40 to over 120 feet and drainage is to the north. The majority of the site is privately owned, with a small parcel on the eastern end owned by the Monterey Peninsula Garbage and Refuse Disposal District.

The site is currently supporting a variety of uses, including grazing, pasture and rural residential. Adjacent uses include: the Salinas River floodplain to the north and east; State Highway 1 and the Southern Pacific Railroad tracks on the western border; and Alternative plant Site 4 (grassland and landfill) to the south.

Future use of the southern portion of the site is listed as urban expansion on the Marina Master Plan; no designation is given to the northern section. Land south of the site is similarly designated as urban expansion and the new State Highway 1 route will pass along the western border. The California Coastal Plan (California Coastal Zone Conservation Commission, 1975) maps the area as grazing land.

Motorists on State Highway 1 can view only the western and northern fringes of Site 5, as rolling hills block the view of the interior. No archeological resources were found in a field survey of the area.

Site 5 is also within the area of Recent (stabilized) sand dune deposits just south of the Salinas River near the coast. The soils typical of the dune area - Oceano loamy sand - are mapped over the entire site.

Alternative Site 6. Treatment plant Site 6 is just north of the Salinas River, approximately 1-1/2 miles south of Castroville. The land is nearly flat and only 10 feet above sea level. Drainage is south into the Salinas River. The site is privately owned.

The site is currently used for growing artichokes and there are two farm houses and associated structures on the site's southern edge. Adjacent properties are also being used to grow artichokes. State Highway 1 passes along the southeastern edge of the property.

County planning for this site is included within the Moss Landing Area Development Plan (Koebig & Koebig, Inc. and Hahn & Wise, 1973) rather than the Marina Master Plan. The plan designates Site 6 and the surrounding area for continued agricultural use. The State Coastal Plan (California Coastal Zone Conservation Commission, 1975) also designates it as agricultural land.

The flat, open nature of Site 6 makes it readily visible to motorists on State Highway 1. The new state route is immediately adjacent to the property. An archeological field survey of Site 6 did not locate surface evidence of archeological resources.

Site 6 is formed of Recent alluvial deposits on the Salinas River floodplain. The only soil type mapped on the area is Pacheco clay loam.

Seismic Conditions Near the Treatment Plant Sites. Burkland and Associates (1975), in their seismic report to Monterey County, identify two categories of seismic hazard in the vicinity of the alternative treatment plant sites. Hazard Zone VI is mapped over all of the sites except the eastern portion of Site 4 (see Figure 28). The Zone VI designation indicates a general condition conducive to lurch cracking, lateral spreading, vibration damage and ground rupture during seismic events. Zone IV indicates less chance for these occurrences, but a relatively greater chance for local subsidence and uplift (see Table D-2). A recent reconnaissance geotechnical study of the sites conducted by John V. Lowney & Associates (1976) indicates a definite liquefaction potential on Sites 3 and 6, but adequate foundation conditions on the other sites. The Lowney report also indicates that the area around the alternative treatment plant sites is likely to experience at least one moderate to major earthquake causing moderate to severe ground shaking during the design life of the project.

Wildlife Use of the Treatment Plant Sites. The grassland vegetation on Sites 1, 2, 4 and 5 supports a limited variety of animal life. The most evident permanent inhabitants are small mammals, including mice, ground squirrels and jack rabbits; and typical grassland-associated birds, i.e., western meadowlark, mourning dove, American kestrel. During fall and spring, migrant birds increase the grassland populations to their highest annual totals. Most of the migrants are small passerine species (sparrows, finches, etc.), but predatory birds (red-tailed hawk, rough-legged hawk) also use the grasslands as feeding grounds. Many seasonal and year-round residents of the riparian habitat along the Salinas River feed in the grasslands of Sites 4 and 5, while using the heavier vegetation along the river for cover and nesting. This includes owls, marsh hawks and white-tailed kites. Sites 1 and 2 are farther from the riparian areas and therefore receive less of this occasional use.

The cultivated lands of Sites 3 and 6 support even less a variety of wildlife. Small mammals, principally mice, and rats, reside in the fields permanently, while prey species (kestrels, marsh hawks, kites, feral cats, owls) that inhabit bordering land use the croplands for feeding grounds. The type and density of animal life on cultivated fields varies significantly with the type of crop, frequency of tilling and presence or absence of weed and pest control measures.

Salinas River Disposal Site

A specific site for the Alternative 134 river discharge has not yet been identified. Its location depends mainly on the treatment plant site chosen. If Sites 1, 2, 3 or 6 are used, the discharge would likely be downstream of the Highway 1 bridge in the lagoon. If Sites 4 or 5 are chosen, the discharge would probably be in the river upstream of the bridge, in the vicinity of the landfill site. Currently, it appears Site 4 is the likely choice for the treatment plant.

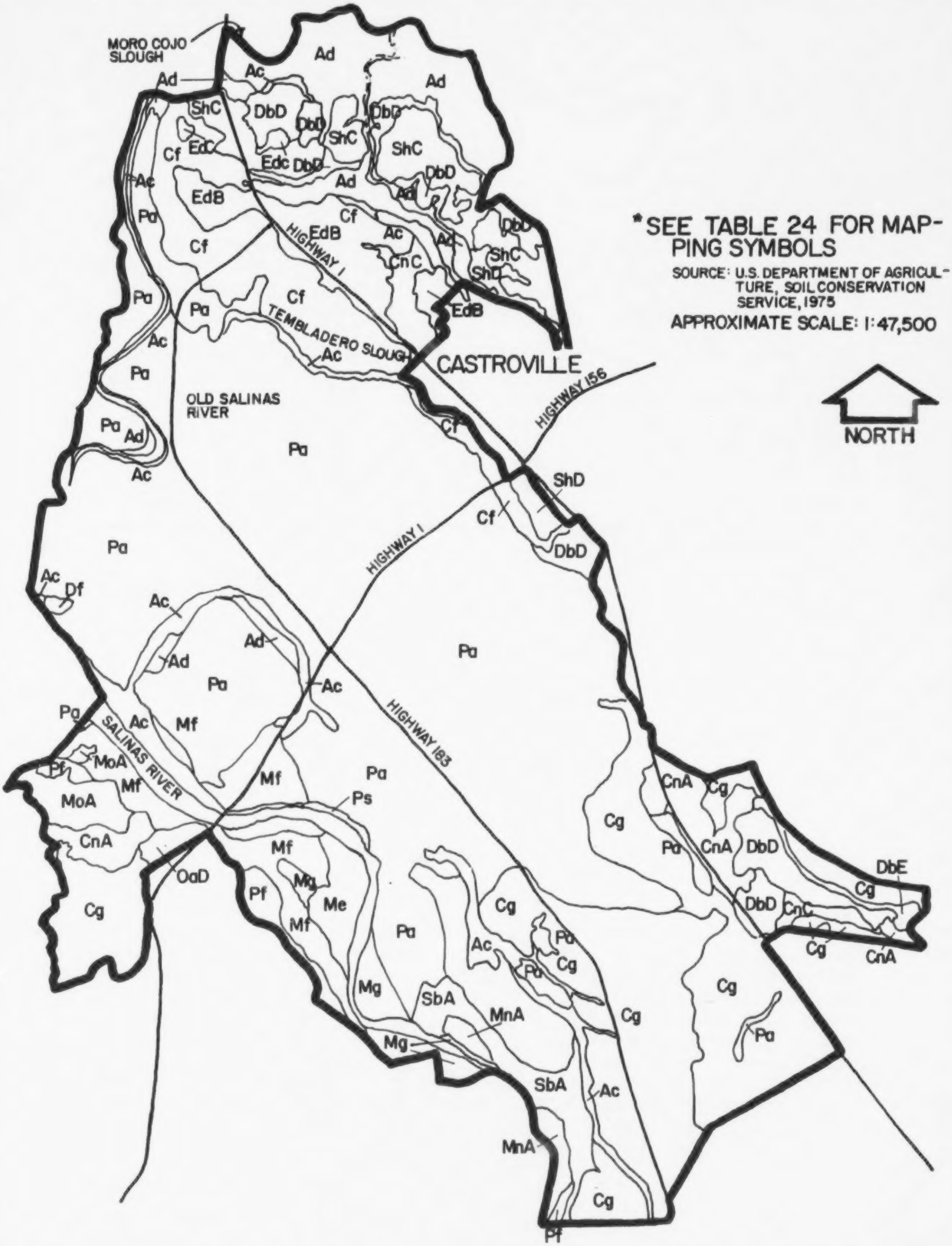
Human use of the lagoon is limited primarily to sport fishing, duck hunting and occasional boating. The land along the north bank is agricultural and that along the south is both agricultural and recreational. A State Department of Fish and Game-managed wildlife area encompasses a major portion of the lower lagoon itself and the non-agricultural land to the south. It is open to the general public for fishing and waterfowl hunting in season. State and local planning for the area suggests that these uses will continue in the foreseeable future.

The river in the vicinity of the Marina landfill site receives little human use. The landfill borders the river on the south and agricultural land lies to the north. Occasional warmwater fishing may occur, but there is no public access to this stretch of the river. The existing land uses should continue in the foreseeable future.

Information on vegetation, fish and wildlife and water conditions in the lagoon and river has been included in preceding Environmental Setting sections.

Irrigation Area - Castroville Irrigation District and Vicinity

In the wastewater reclamation and irrigation reuse alternatives, land near Castroville is likely to be used for irrigation reuse of wastewater. The project engineers have specified the Castroville Irrigation District (CID) as the most likely reuse area, but in actuality, surrounding land could also be used. The following description includes all land within the CID boundaries. The District is actually Zone 6 of the Monterey County Flood Control and Water Conservation District and includes 9,000 acres of agricultural land in the Moss Landing-Castroville area (see Figure 29).



*SEE TABLE 24 FOR MAPPING SYMBOLS

SOURCE: U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, 1975

APPROXIMATE SCALE: 1:47,500

FIGURE 29 SOILS OF THE CASTROVILLE IRRIGATION DISTRICT

The District occupies the lower Salinas River alluvial plain; loam and clay loam soils are dominant in this area. Clear Lake clays and Pacheco clay loams occupy the greatest areas, but smaller parcels of Alviso, Cropley, Diablo, Elkhorn, Metz, Mocho, Oceano, Salinas and Santa Ynez soil types are within the District. (Table 24 lists some of the general soil characteristics and Figure 29 maps their distribution.)

Runoff from the District is carried by the Salinas River, Old Salinas River, Tembladero, Moro Cojo and Alisal Sloughs and the Main Reclamation Ditch. Periodic high water levels in these drainages and in the subsurface combine with relatively slow percolation rates to make drainage a frequent problem in the District. High water table problems are especially prevalent in the winter months along the drainageways. In most places, however, the upper unconfined water table is more than 6 feet below the surface (U.S.D.A. Soil Conservation Service, 1975).

Artichokes and lettuce are by far the dominant crops grown in the District. Smaller acreages of celery, broccoli and cabbage are found in scattered locations. The only other land use of consequence in the District is grazing, which occurs on the lowlands near Moro Cojo Slough, just east of Moss Landing. The land surrounding the District is also primarily agricultural, with the exception of the Moss Landing and Castroville urban areas on the north. The coastline west of the District boundary is heavily used by recreationists.

Surface and Subsurface Storage Areas

The proposed storage reservoirs for Alternatives 170 and 171, although not specifically located, would probably be in close proximity to the regional wastewater treatment plant somewhere south of the Salinas River. This rolling duneland previously described as Alternative Treatment Plant Sites 4 and 5 offer the best natural features for percolation and subsurface storage (Metcalf & Eddy, 1975).

The soil in the area is Oceano loamy sand (Table 24). The high percolation rate (6-20 inches per hour) and depth to groundwater (estimated to be 50 feet in Metcalf & Eddy, 1975) in this area make it attractive as either a percolation-infiltration disposal or underground storage site. The permeability and slope are not conducive to surface storage, however. For a further description of the general area, refer to the site specific environments of treatment plant Sites 4 and 5.

Table 24

SOILS MAPPED WITHIN THE CASTROVILLE IRRIGATION DISTRICT

Mapping Symbol	Soil Phase*	Land Capability Unit	Depth Inches	Permeability Inches/Hour	Available Water Capacity In./In.	Soil Reaction	Salinity Mmhos/cm	Erosion Factors		Flooding	High Water Table Depth-Ft.	Bedrock Depth-Inches	Factors Adversely Affecting Water Management Features:	
								K	T				Drainage	Irrigation
Ac	Alviso silty clay loam	VIIIw1	0-14 14-45	0.06-0.6 0.06-0.2	0.07-0.15 0.07-0.15	6.6-8.4 6.6-8.4	>2 >2	— —	- -	Common-brief	0.0-1.0 Jan-Dec	>60	Poor outlets, wetness, floods	Wetness, excess salt, percs slowly
Ad	Alviso silty clay loam drained	IVw6	0-14 14-45	0.06-0.6 0.06-0.2	0.07-0.15 0.07-0.15	6.6-8.4 6.6-8.4	>2 >2	— —	- -	Rare	1.0-2.0 Jan-Dec	>60	Wetness, poor outlets	Wetness, percs slowly, excess salt
Cf	Clear Lake clay	IIIw5	0-33 33-62	0.06-0.2 0.06-0.2	0.10-0.16 0.10-0.16	6.1-7.3 6.1-8.4	<6 <6	0.24 0.24	5	Common-brief	1.0-3.0 Oct-Mar	>60	Wetness, percs slowly	Wetness, slow intake
Cg	Clear Lake clay, moderately wet	IIw5	0-33 33-54	0.06-0.2 0.06-0.2	0.13-0.16 0.17-0.19	6.1-8.4 7.4-8.4	<4 <2	0.24 0.24	5	Common-brief	3.0-5.0 Jan-Dec	>60	Wetness, percs slowly, floods	Wetness, floods, slow intake
CnA	Cropley silty clay, 0-2% slopes	IIs5	0-69	0.06-0.2	0.13-0.17	6.6-8.4	<2	0.24	5	None	>6.0	>60	Percs slowly	Slow intake, percs slowly
CnC	Cropley silty clay, 2-9% slopes	IIe5	0-69	0.06-0.2	0.13-0.17	6.6-8.4	<2	0.24	5	None	>6.0	>60	Percs slowly, slope	Slow intake, percs slowly, slope
DbD	Diablo clay, 9-15% slopes	IIIe5	0-53	0.06-0.2	0.14-0.19	6.1-8.4	<2	0.24	3	None	>6.0	40-60	Complex slope, percs slowly	Complex slope, slow intake, percs slowly
DbE	Diablo clay, 15-30% slopes	IVe5	0-53	0.06-0.2	0.14-0.19	6.1-8.4	<2	0.24	3	None	>6.0	40-60	Complex slope, percs slowly	Complex slope, slow intake, percs slowly
Df	Dune land	VIIIe1	—	—	—	—	—	—		—	—	—	—	—
EhB	Elkhorn fine sandy loam, 2-5% slopes	IIe1	0-26 26-46	2.0-6.0 0.2-0.6	0.11-0.15 0.14-0.18	5.6-7.3 5.6-7.3	<2 <2	0.32 0.28	5	None	>6.0	>60	Slope, percs slowly	Slope
EhC	Elkhorn fine sandy loam, 5-9% slopes	IIe1	0-26 26-46	2.0-6.0 0.2-0.6	0.11-0.15 0.14-0.18	5.6-7.3 5.6-7.3	<2 <2	0.32 0.28	5	None	>6.0	>60	Slope, percs slowly	Slope
Me	Metz loamy sand	IIIs4	0-12 12-99	6.0-2.0 0.6-2.0	0.07-0.11 0.07-0.10	6.6-8.4 6.6-8.4	<2	0.17 0.15	5	None	>6.0	>60	Favorable	Fast intake, droughty
Mf	Metz fine sandy loam	IIs4	0-12 12-99	2.0-6.0 0.6-2.0	0.13-0.17 0.07-0.10	6.6-8.4 6.6-8.4	<2 <2	0.28 0.15	5	None	>6.0	>60	Favorable	Fast intake, droughty
Mg	Metz complex	IVe4	0-12 12-99	6.0-20.0 0.6-2.0	0.07-0.11 0.07-0.10	6.6-8.4 6.6-8.4	<2 <2	0.17 0.15	5	None	>6.0	>60	Slope	Slope, fast intake, droughty
MnA	Mocho silt loam, 0-2% slopes	I	0-68	0.6-2.0	0.16-0.20	7.4-8.4	<2	0.43	5	None	>6.0	>60	Favorable	Favorable
MoA	Mocho silty clay loam, 0-2% slopes	I	0-68	0.2-0.6	0.18 0.18-0.21	7.4-8.4	<2	0.37	5	None	>6.0	>60	Favorable	Favorable
OaD	Oceano loamy sand, 2-15% slopes	IVe4	0-80	6.0-20.0	0.05-0.08	5.6-7.3	<2	0.10	5	None	>6.0	>60	Slope, cutbanks cave	Complex slope, droughty, fast intake
Pa	Pacheco clay loam	IIw2	0-65	0.2-0.6	0.18-0.21	6.1-8.4	<15	0.43	5	None to rare	3.0-5.0 Dec-May	>60	Wetness, excess salt	Wetness, excess salt
Pf	Pico fine sandy loam	I	0-55 55-72	2.0-6.0 0.6-2.0	0.13-0.15 0.03-0.05	7.4-8.4 7.9-8.4	<2 <2	0.20 0.10	5	None	>6.0	>60	Favorable	Favorable
Ps	Psamments and fluvents, frequently flooded	VIIIw1	0-60	76.0-72.0	0.03-0.05	6.6-7.3	<2	—		Common-brief to very long	2.0-6.0 Oct-Jun	>60	Floods, wetness, poor outlets	Floods, wetness, droughty
SbA	Salinas clay loam, 0-2% slopes	I	0-5 5-75	0.2-0.6 0.2-0.6	0.18-0.21 0.16-0.20	6.6-7.3 6.6-8.4	<2 <2	0.37 0.43	5	None	>6.0	>60	Favorable	Favorable
ShC	Santa Ynez fine sandy loam, 2-9% slopes	IVe3	0-18 18-43	0.6-2.0 <0.06	0.09-0.16 0.01-0.03	5.6-7.3 5.6-7.8	<2 <2	0.43 0.37	1	None	>6.0	>60	Slope, percs slowly	Slope, percs slowly, rooting depth
ShD	Santa Ynez fine sandy loam, 9-15% slopes	IVe3	0-18 18-43	0.6-2.0 <0.06	0.09-0.16 0.01-0.03	5.6-7.3 5.6-7.8	<2 <2	0.43 0.37	1	None None	>6.0	>60	Slope, percs slowly	Slope, percs slowly, rooting depth

* Soil terminology defined in the Glossary.

Source: U. S. Department of Agriculture, Soil Conservation Service, 1975.

Ocean Outfall - South-Central Monterey Bay

Inasmuch as the currently favored outfall location for the marine disposal alternative would be somewhere along the coast of Monterey Bay south of the Salinas River and north of Fort Ord, some more detailed consideration of this area is desirable.

It appears that the general circulation of this part of Monterey Bay is, like the rest of the bay, governed primarily by oceanic events (the "offshore current structure"), and that for the most part there is good mixing and exchange with the open sea. In the southern end of the Bay, however, there is a tendency for a more or less persistent gyre behind Pt. Pinos, in the area of Monterey Harbor, with a tendency toward sluggish circulation indicated near shore along the entire region (Figure 25). Also, the longshore current, which influences circulation at or near the surf line and the movement of sands and larger materials, is prevailingly to the south in Monterey Bay.

The Central Coastal Basin _Water Quality Control Plan Report_ (California State Water Resources Control Board, 1975a) recognized this area of poor circulation in the south bay and subsequently established a waste discharge prohibition area landward of a line drawn between Pt. Pinos and the mouth of the Salinas River (Figure 24). The Basin Plan also noted that agricultural waste discharges to the Salinas River and subsequently to the bay were probably creating a buildup of pesticides in the bottom sediments near the mouth of the river. This area and areas of high nutrients due to wastewater discharges and ocean upwelling are shown in Figure 25.

Since January of 1976, Engineering Science, Inc. has been monitoring subsurface ocean current speed and direction at two locations and at two depths in the anticipated outfall area. The results of the first six months of this monitoring indicate that predominant currents at the station just south of the mouth of the Salinas River are predominantly up-coast or down-coast. (Both directions are 75° sectors established with reference to a baseline perpendicular to the coast.) This is true at the 9-, 15- and 25- meter depths (current meters moved from 15- to 25-meter depth after April). At the station just north of the mouth of the river, a similar condition was recorded, with a slightly greater tendency for up-coast onshore currents at the 9-meter depth. Average current speeds ranged from a minimum of 6.0 cm/second to a maximum of 14.3 cm/second at the 9-meter depth, with a slightly similar range of 5.6 to 15.5 cm/second at the 15-meter depth (Engineering Science, Inc., 1976f). At the 25-meter depth, measured since

April, the current speeds have ranged from an average minimum of 3.7 cm/second to a maximum of 9.7 cm/second. Figure G-1 and Tables G-1 and G-2 display the full results of this 6-month current metering. It should be noted that the detailed data collected to date do not necessarily represent conditions throughout the year, as current patterns may change significantly with changes in the season.

The principal biotic communities in southern Monterey Bay are summarized in Table 25. Of these, the rocky shore community is quite distant from the proposed outfall location and is therefore not likely to be affected. The nearshore and subtidal sands and muds community is influenced by variation in physical factors such as surf, wave direction, long shore drift and heavy storms much more than the other communities in the area. Further, as already indicated, abundance of one species over another varies from time to time according to the success of larval swarms (often from some distance away), and food supply (mostly allochthonous on a sandy, intertidal shore). Accordingly it is not surprising that quantitative samples may vary to a greater extent than expected from sampling error. The situation is further complicated by the tendency of some organisms of this environment to move, often in herds. The sand dollar, for example, tends to orient itself with respect to the low tide line or some level below low tide, (as an upper limit) but will move laterally for some distance throughout the season (Merrill & Hobson, 1970). This orientation with respect to depth suggests that raised obstructions, such as a pipe line on the bottom, may interrupt such movement, as they may not change their depth orientation.

Seaward of this zone two sets of samples have been made in connection with other surveys (PG&E) which indicate the character of the bottom associations in this part of Monterey Bay (Table I-1).

Brief accounts of the characteristic benthos for these stations are as follows:

Station 21 is located 10,500 feet south of Moss Landing at a depth of nine fathoms (54'). Animal abundance by percent composition and mean weight is shown in Table I-1. The bottom fauna consisted primarily of an amphipod-ostracod-sand dollar (*Dentraster excentricus*) association. The spionid polychaete *Prionospio pygmaeus* and the bivalve *Tellina buttoni* were also abundant. Later studies in 1968 found juvenile sand dollars as the dominant animal, with ostracods and spionid polychaetes close behind. The mollusk *Hiatella artica* also comprised a substantial amount of the sample. This station appeared to

Table 25

MARINE BIOTIC COMMUNITIES OF THE MONTEREY BAY AREA

Community	Locations and Examples	Characteristic Plants	Characteristic Animals
Open coast	*Rocky shore*: mostly subject to wave and tidal action, along coast of Monterey Peninsula beginning at Municipal Wharf No. 1. Examples: Cannery Row, Hopkins, Marine Station, Point Pinos.	*Prasiola* sp., rock weeds (*Fucus; Pelvetiopsis*), sea lettucs (*Ulva* sp.), *Endocladia* and many other algae, surf grass, (*Phyllospadix*), and goats beard (*Aruncus vulgaris*).	Periwinkles (*Littorina planaxi*), limpet (*Colisolla* sp.), acorn barnacles (*Balanus glandula*), brown barnacles (*Chthamalus dalli*), mussels (*Mytilus californianus*) goose barnacle (*Pollicipes polymerus*), and ochre sea star (*Pisaster ochraceus*), seagulls, brown pelican (*Pelacanus occidentalis*), double crested cormorant (*Phalacrocorax auritus*), Brandt's cormorant (*P. pencillatus*), phalaropes (*Phalaropus* sp., *Steganopus* sp. *Lobipes* sp.)
	Sandy beach: exposed inner coast of Monterey Bay from Santa Cruz to the Monterey Peninsula. Examples: Zmudowski, Monterey, Marina, Seaside and Salinas River Beaches.	Surf grasses (*Phyllospadix torreyi* and *P. scouleri*), beach and sand verbena (*Abronia latifolia* and *A. umbellata*).	Great beach hopper (*Orchestoidea californiana*), pill bug (*Ligia occidentalis*), mole crab (*Emerita analoga*), Pismo clam (*Tivela stultorum*), bean clam (*Donax gouldi*) various polychaetes, killdeer (*Charadrius vociferus*), spotted sand piper (*Actitis macularis*) and various seagulls. At or below low tide: Sand dollar (*Dendraster excentricus*), amphipods (*Eohaustorius* sp.), various polychaetes, tellinid clams (*Tellina* sp.).
Coastal strand	Beaches and sand dunes along inner coast of Monterey Bay from Moss Landing to Monterey Municipal Wharf No. 2. Examples: Salinas River State Beach, Fort Ord	Silky beach pea (*Lathyrus littoralis*), sea rocket (*Cakile edentula*), Hottentot and sea figs (*Mesembryanthemum edule* and *M. chilense*), marrom grass (*Ammophila arenaria*), coast eriogonum (*Eriogonum latifolia*), blue beach lupine (*Lupinus chamissonis*), sand verbena (*Abronia* sp.), beach primrose (*Oenothera cheiranthifolia*) and beach morning glory (*Convolvulus soldanella*).	California legless lizard (*Anniella pulchra*), black-tailed jackrabbit (*Lepus californicus*), brush rabbit (*Sylvilagus bachmani*), Salinas Valley kangaroo rat (*Dipodomys* sp.), sanderling (*Crocethia alba*), snowy plover (*Charadrius alexandrinus* and killdeer (*Charadrius vociferus*).
Coastal salt marsh (and estuary)	Salt marshes in semi-protected estuaries and sloughs along Monterey Bay.	Pickleweed (*Salicornia ambigua*), sea blite (*Suaeda californica*), march grindelia (*Grindelia cuneifolia*), marsh rosemary (*Limonium commune*), saltgrass (*Distichlis spicata*), salt brush (*Atriplex leucophylla*) and California cord grass (*Spartina foliosa*). At or below low tide: eel grass (*Zostera marina*).	Bay mussels (*Mytilus edulis*), horse mussel (*Volsella diegensis*), eastern and Pacific oysters (*Crassostrea virginica* and *C. gigas*) bent-nosed clam (*Macoma nasuta*), Washington clam (*Sacidomus nuttallii*), gaper clam (*Tresus nuttallii*), Japanese little-neck clam (*Tapes semidecussata*), barnacles (*Balanus* sp.), ghost shrimp (*Callianassa* sp.), sanderlings (*Crocethia alba*), red-winged blackbird (*Agelaius phoenicus*) marsh hawk (*Circus cyaneus*), western grebe (*Aechmorphorus occidentalis*), and American coot (*Pulica americana*).

be fairly homogeneous where the fauna was evenly distributed rather than in clumps. The visible amount of organic debris was low compared to locations farther inshore and may have reduced the habitat and relative abundance of polychaetes (Chartock, 1969).

Station 17 was located 5,200 feet south of Moss Landing at a depth of eight fathoms (48'). The eight most abundant animal taxa are shown in Table I-1.

> "Station 17 had an animal association similar to station 21. Dendraster excentricus, however, was less abundant at this station in June 1966 when compared with station 21 (Student's test level of significance 0.03). During October 1966 and July 1967, abundance of the amphipod Eohaustorius sencillus was greater at station 21 than 17. This pattern conforms to the general picture of greater crustacean abundance offshore than near shore. Although differences in animal abundance between dates were statistically significant in many cases, these changes did not represent changes in the animal associations, as seasonal and clumping variations did not alter these groupings." (Chartock, 1969)

In the 1968 study, the benthic fauna was dominated by Dendraster excentricus, ostracods and spionid polychaetes, in that order. As in Station 21, Hiatella arctica was also the dominant mollusk.

Shoreward of the surf and subtidal zones are several characteristic maritime and lowland associations or biotic communities. The two most vulnerable to the construction phase of any project involving a marine outfall are the coastal strand and coastal salt marsh. They are included in Table 25 and summarized as follows:

Coastal Strand. At the central and southern periphery of Monterey Bay, the coastal strips are characterized by a continuous relatively narrow sand beach without rocky promontories. Behind this beach are low shifting sand dunes graduating up to higher semi-stabilized sand dunes. Vegetation in the beach and dune area is generally low or prostrate, often succulent and usually late-flowering. Due to the shifting nature of the sand and the shallow-rooted vegetation, the dune communities are rather fragile environments of limited range. The largest and least disturbed length of dune habitat lies between Moss Landing and the Fort Ord military reservation. Representative plant and animal species for the coastal strand community are given in Table 25. Due to human influences upon the sand dunes, several endemic plant species have now become rare or endangered.

Coastal Salt Marsh. The coastal salt marsh community, considered to be one of the most ecologically significant communities of the Pacific Coast, appears naturally in the study area only at Elkhorn Slough and near the mouth of the Salinas River. The old Salinas River channel and nearby ponds, although not the true tidal salt marshes, also provide valuable resting and nesting areas.

Elkhorn Slough is currently a candidate area for a national wildlife refuge. Vegetation within the salt marsh is distinctive because of its ability to withstand inundation and high levels of dissolved salts. Vegetation is generally low and often has reduced succulent leaves (e.g., pickleweed) to withstand water loss. The vast tidal expanses are rich feeding grounds for thousands of resident and migratory shorebirds and waterfowl. The main birds common to Elkhorn Slough and adjacent areas are of four types: fish eaters such as herons, egrets and terns; invertebrate eaters (snails, clams, worms) such as willets, curlews and avocets; filter feeders such as ducks; and finally the scavengers such as sea gulls.

Rare and endangered species particular to the salt marsh habitat include the California clapper rail (Rallus longirostris), the least tern (Sterna albifrons), and the salt marsh harvest mouse (Reithrodontomys raviventris).

LEGAL, REGULATORY AND INSTITUTIONAL CONSTRAINTS

Introduction

The following is a checklist of governmental agencies and departments that have either regulatory authority or planning responsibility that may affect the planning and implementation of a wastewater treatment and disposal project in Monterey County. Only those permit requirements, regulatory policies and legal responsibilities that may influence a project in this area are mentioned. Those that have influenced selection of the project alternatives are mentioned in the Alternative Projects section of the report. The major implementing and regulatory agencies are listed in the first section; other permit and planning agencies are included in the two following sections.

Major Implementing and Regulatory Agencies

U. S. Environmental Protection Agency

The Environmental Protection Agency (EPA) is charged with administering the Federal Water Pollution Control Act, the Federal Clean Air Act and the Federal Safe Drinking Water Act. Under terms in the Water Pollution Control Act, EPA was required to prepare and enforce minimum water quality standards for the nation. The 1972 amendments to this act established the National Pollution Discharge Elimination System, which allows EPA to require a permit for any discharge of waste materials to a waterway. Because California has an equivalent to the Water Pollution Control Act (Porter-Cologne Act), the federal government has delegated major authority to the California State Water Resources Control Board (SWRCB) in establishing and enforcing water quality standards. The RWQCB's are performing the majority of the regulatory functions. The North Monterey County wastewater treatment system is being developed to meet both state and federal discharge standards. In order to comply with the Water Pollution Control Act timetable, all treatment plants discharging to surface waters must meet the *federal secondary treatment effluent requirements* by July 1, 1977 (listed in Federal Register, Vol. 40, No. 159, August 15, 1975 - see Table N-5). By July 1, 1983, all municipal treatment facilities must have instituted "Best Practicable Waste Treatment Technology". By July 1, 1985, municipal treatment facilities must have reached a condition of no discharge of pollutants. In this definition, complete elimination of discharge is not implied; only elimination of discharge of pollutants, where a pollutant is defined as anything that adversely affects the quality of water necessary to support a beneficial use.

The implications of this requirement within northern Monterey County are that the Salinas and Castroville wastewater discharges must either be removed from surface waters or improved in quality so that the beneficial uses assigned to their receiving waters are not adversely affected (EPA water quality criteria to protect beneficial uses are listed in Table N-3). All ocean discharges must meet the federal secondary effluent requirement.

Under Section 208 of the Federal Water Pollution Control Act, EPA is also responsible for approving plans and programs to control "non-point" source pollution. The state must identify regions with "substantial water quality control problems" and authorize a single organization to operate "a continuing areawide waste treatment management planning process". The Association of Monterey Bay Area Governments (AMBAG) has been designated to conduct the non-point source control study in this project's study area. Agricultural runoff, sea water intrusion and mine-related pollution are some of the major non-point source targets of 208 planning. Efforts are being made to coordinate 208 planning and all Facilities Planning (including the MPWPCA Plan) in the Monterey-Salinas area.

EPA also participates in the Clean Water Grant program which funds wastewater system improvement projects. This funding system is also operated jointly with the state; the SWRCB has been given primary responsibility in administration of the program. This EIS is a required element of the application for Clean Water Grant funds.

In administering the Federal Clean Air Act, EPA has established National Ambient Air Quality Standards (NAAQS; see Table 2). These standards are designed to protect human health from the effects of chronic air pollution. Any project that creates local air pollution conditions in excess of NAAQS may have federal funding withheld. A further explanation of EPA's role in maintenance of air quality is presented in the Air Quality section of the Environmental Setting.

The Federal Safe Drinking Water Act of 1974 required EPA to set standards for drinking water quality and to establish guidelines for state regulation and enforcement of these standards. It also gave EPA the responsibility of protecting underground sources of drinking water. Protection will probably be implemented by requiring permits for injection of wastes into usable aquifers and by prohibiting waste disposal operations that will endanger the quality of drinking water sources. National interim primary drinking water regulations were recently released by EPA (Federal Register - Vol. 40, No. 248 - Wednesday, December 24, 1975). A drinking water protection program will probably be implemented by the SWRCB once it is defined by EPA. Any option of land disposal of wastewater or sludge adopted as part of this proposed regional wastewater system will be analyzed by EPA for its effects on local drinking water supplies.

California State Water Resources Control Board (SWRCB)

The SWRCB is responsible for administering portions of the Federal Water Pollution Control Act and California's Porter-Cologne Act. Under conditions of these acts, the SWRCB has required the Central Coastal Regional Water Quality Control Board (RWQCB) to prepare a basin plan for maintenance of water quality along California's central coast. The basin plan and its water quality objectives have been approved by the SWRCB. They must also review all discharge requirements placed on treatment plants in the project area by the RWQCB. The SWRCB is the administrator of California's Clean Water Grant funds and the principal reviewer of this project's application for state and federal funding, including the facilities plan.

The SWRCB basin plan - "Water Quality Control Plan Report -- Central Coastal Basin" - was adopted in 1974. The purpose of this plan was: 1) the establishment of beneficial uses (see Table N-2) for water bodies within the Central Coastal Basin, 2) development of water quality standards compatible with such beneficial uses, 3) definition of the level of treatment necessary to attain or maintain these standards and ensure continuance of the beneficial uses, and 4) description and evaluation of alternative water quality management plans (the SWRCB recommended plan is included in Appendix N). In the determination of objectives and standards in the Water Quality Control Plan, numerous other SWRCB plans and policies were adhered to; these are also listed in Appendix N. All of these water-related policies must be considered in developing a facilities plan if the SWRCB is to grant state and rederal funds toward construction of a project.

In addition, the SWRCB requires that all projects funded under the Clean Water Grant Program give consideration to conjunctive management of surface/groundwater resources with wastewater resources. Recent changes in the Clean Water Grant Program regulations (Title 23, California Administrative Code, Chapter 3, Subchapter 7) make the development of wastewater reclamation facilities a secondary objective of the Clean Water Bond Law and the State Clean Water Fund. This makes encouragement of wastewater reclamation projects an official policy of the SWRCB. Clean Water Grant funding of reclamation distribution systems has been expanded as an added incentive. The increasing emphasis on reclamation is designed to meet the growing water requirements of the state, especially in those areas that are already water-short.

The SWRCB has also prepared the Water Quality Control Plan - Ocean Waters of California which includes water quality objectives, effluent quality requirements and management principles for waste discharge to the ocean. The policies and objectives of this document must be considered if any ocean outfall is constructed as part of the MPWPCA regional treatment facility. The ocean water quality objectives of the plan are reflected in the water quality criteria for the marine life beneficial use in Table N-3. The plan's quality requirements for waste discharges are listed in Table 26.

Central Coastal Regional Water Quality Control Board (RWQCB)

California's RWQCBs have the principal responsibility for enforcing the Federal Water Pollution Control Act and the state's Porter-Cologne Act. The SWRCB establishes water quality policy and the RWQCB implement or enforce that policy by issuing waste discharge permits, establishing waste discharge requirements for individual dischargers and monitoring the quality of wastewater discharges. The SWRCB has recently adopted a Water Quality Control Plan for the central coastal basin. The water quality objectives and beneficial uses established in that plan for waters within the study area are listed in Tables N-3 and N-2, respectively. Table N-1 presents the Board's recommended treatment requirements for various wastewater disposal options that could be used in the central coastal basin. All alternatives developed for this project must satisfy waste discharge requirements which could be expected to be established by the Central Coast RWQCB. The regional board is currently enforcing a discharge prohibition to southern Monterey Bay shoreward of a line between Pt. Pinos and the mouth of the Salinas River. This plays an important role in the location of any new ocean outfalls to the bay. Other discharge prohibitions being enforced by the Central Coastal RWQCB are listed in Appendix N.

Table 26

QUALITY REQUIREMENTS FOR WASTE DISCHARGES TO OCEAN WATERS (EFFLUENT QUALITY REQUIREMENTS)

		Concentration not to be exceeded more than:	
	Unit of Measurement	50% of Time	10% of Time
Grease and Oil (hexane extractables	mg/l	10.	15.
Floating Particulates (dry weight)	mg/d	1.0	2.0
Suspended Solids	mg/l	50.	75.
Settleable Solids	ml/l	0.1	0.2
Turbidity	JTU	50.	75.
pH	units	Within limits of 6.0 to 9.0 at all times.	
Arsenic	mg/l	0.01	0.02
Cadmium	mg/l	0.02	0.03
Total Chromium	mg/l	0.005	0.01
Copper	mg/l	0.2	0.3
Lead	mg/l	0.1	0.2
Mercury	mg/l	0.001	0.002
Nickel	mg/l	0.1	0.2
Silver	mg/l	0.02	0.04
Zinc	mg/l	0.3	0.5
Cyanide	mg/l	0.1	0.2
Phenolic Compounds	mg/l	0.5	1.0
Total Chlorine Residual	mg/l	1.0	2.0
Ammonia (expressed as nitrogen)	mg/l	40.	60.
Total Identifiable Chlorinated Hydrocarbons	mg/l	0.002	0.004
Toxicity Concentration	tu	1.5	2.0
Radioactivity		Not to exceed the limits specified in Title 17, Chapter 5, Subchapter 4, Group 3, Article 5, Section 30285 and 30287 of the California Administrative Code.	

Source: California State Water Resources Control Board, 1972.

California Department of Health

The California Department of Health has established water quality standards for use of reclaimed wastewater in crop irrigation. These standards are described in the California Administrative Code (Title 22, Sections 60301-60357; see Appendix O). The quality of discharge waters reaching domestic water supplies is also a Department of Health concern. Wastewater must not lower domestic water supply quality below the California Domestic Water Supplies Quality Standards. The irrigation disposal and impoundment of effluent proposed in several of the project alternatives is therefore subject to Department of Health regulation and monitoring. The majority of the regulation and monitoring is actually accomplished by the RWQCBs which follow the Department of Health Standards in setting waste discharge requirements for individual dischargers. The Department of Health can also act unilaterally in ensuring compliance with the standards, however.

The State Department of Health currently has no regulation stipulating a minimum farm labor reentry period for agricultural areas irrigated with wastewater. Concern was expressed at several local public meetings that such a restriction could adversely affect the normal harvesting procedure for some crops, especially lettuce. The timing of final irrigation and harvesting is critical to getting some crops to market in the best possible condition, thereby demanding the best possible price. The Health Department does, however, have guidelines for irrigation use of reclaimed wastewater (see Appendix O). These guidelines must be considered if irrigation reuse is adopted as part of the MPWPCA regional wastewater system.

Monterey County Environmental Health Department (MCEHD).

The MCEHD has the authority to halt any violation of the California Health and Safety Code. This includes contamination of domestic, agricultural or recreational waters, creation of hazardous vector populations, or creation of hazardous working conditions on the agricultural lands of the county. The MCEHD periodically monitors local water quality in order to detect unsafe conditions. The waste disposal or reclamation and reuse options adopted as part of the plan will be monitored by the Health Department for compliance with state Health and Safety Code legal requirements and State Health Department regulations, policies and guidelines.

California Coastal Zone Conservation Commission (CCZCC)

The CCZCC was established: "1) to prepare a comprehensive, coordinated, enforceable plan for the orderly, long-range conservation and management of the natural resources of the coastal zone, and 2) during the planning period, to regulate development in coastal waters and in a 1,000-yard shoreline permit area to ensure that improper development did not undercut the plan being prepared" (California Coastal Zone Conservation Commission, 1975). The near-coastal portion of the project study area lies within the CCZCC's permit area and a large part of the remainder of the study area lies within its coastal resource management area. Any facilities construction within the permit area would be subject to CCZCC review and approval. Activity within the resource management area should be analyzed as it relates to coastal plan policy and land use proposals.

In preparing the Coastal Plan, the valuable natural resources of the plan study area were identified. Those most worthy of protection have been recommended for acquisition by the Coastal Commission. This information is being used by various state and federal agencies, including EPA, the SWRCB and the Central Coastal RWQCB to evaluate planned development along the coast. The effect of the North Monterey County Facilities Plan on these resources is considered in this EIS.

Other Permit/Regulatory Agencies

U. S. Coast Guard - would regulate pipeline construction in bay waters to ensure boat safety.

U. S. Department of the Army, Corps of Engineers - would require a Section 404 (Federal Water Pollution Control Act) permit for any dredging or placement of spoil in the bay that might accompany construction of an ocean outfall. The Corps of Engineers has been conducting studies of alternative water resources planning strategies in the Salinas-Monterey area as part of their Urban Studies Program. A report on wastewater management options for land application in the area has recently been completed by Metcalf & Eddy Engineers as part of thie urban study. The report has been used to augment wastewater management studies conducted by the North Monterey County facilities plan engineers.

California Department of Fish and Game - would require a Section 1602 (California Fish and Game Code) permit for any modifications of stream flow, banks or channels resulting from implementation of the proposed project. This includes pipeline construction across the Salinas River.

California Department of Parks and Recreation - helps to administer the National Historic Preservation Act in California; ensures protection of National Register of Historic Places sites and California Historical Landmarks from state and federally-funded projects.

California State Lands Commission - would require a lease of state property for construction of an outfall along the bottom of Monterey Bay.

Monterey Bay Unified Air Pollution Control District - would require a permit for flaring of digester gas or incineration of sludge at a new wastewater treatment plant if these operations were used.

County of Monterey - would require permits for changes in land use, pipeline construction along county roads and construction of structures on the treatment plant site. The Board of Supervisors must approve the regional wastewater plan before it can be implemented.

Local Agency Formation Commission - must issue a permit for formation of a new wastewater project implementation district.

Interested Planning Agencies

California Department of Water Resources - currently studying wastewater reclamation and its potential effect on the state's water resources; they are therefore interested in coordinating their planning efforts with the reclamation proposals of the MPWPCA Facilities Plan.

Association of Monterey Bay Area Governments - is currently conducting the 208 planning effort for the Monterey-Santa Cruz area; this effort is being coordinated with the 201 facilities planning.

Cities and Special Districts - the zoning ordinances and land use and facilities plans of the various incorporated cities and special sanitation districts must be taken into consideration in developing a regional wastewater facilities plan.

ALTERNATIVE PROJECTS

Introduction

Preparation of an EIS is required when any federally-funded or federally-regulated project will significantly affect the human environment. U. S. Environmental Protection Agency regulations for preparation of an EIS (Federal Register 38(11), 1973) require discussion and evaluation of alternatives to a proposed project when significant resource tradeoffs are involved. Section 201 of PL 92-500 also requires discussion of alternative waste management techniques. The purpose of this chapter is to briefly describe the processes and procedures which were utilized in screening a substantial number of alternatives down to the five most desirable alternatives. These five alternatives will then be described in detail in a fashion understandable by the general public. Should the reader desire more detailed technical information on treatment processes and effluent quality, he is referred to the companion document to this EIS, the "Facilities Plan for North Monterey County", prepared by Engineering Science, Inc. for the Monterey Peninsula Water Pollution Control Agency.

Objectives of Regionalized Wastewater Treatment

Regionalization of wastewater treatment as proposed by the SWRCB is actually centralization of wastewater management. It does not necessarily require consolidation of all waste flows into a single regional treatment facility. It encourages placing the management of wastewater treatment and disposal for a relatively large geographic area into the hands of a single agency. Regionalized management has in the past proven to be more reliable in operating and maintaining treatment systems than has scattered individual management units. Several degrees of regionalization have been considered in planning for northern Monterey County. Besides the complete consolidation proposed in the Facilities Plan, maintenance of separate systems for Salinas, Castroville, Marina or some combination of these areas was analyzed. Costs, environmental impact, engineering feasibility and conformance with legal requirements were all part of the analysis. The reasons for bypassing these subregional options are detailed in the following "Development of Alternatives" section.

A prime objective of regionalizing wastewater treatment is to reduce or eliminate existing and potential water quality problems in the most "cost-effective" manner. Cost-effectiveness includes three very important factors: monetary or dollar costs; environmental costs; and social costs. The most cost-effective project is that project which meets the project objectives with the lowest combined economic, environmental and social costs. Regionalization can reduce costs of attaining water quality standards by centralizing management, operation and maintenance. Environmental aspects may be minimized by restricting wastewater plants and discharges to single rather than multiple locations. The social implications of regionalization are simply that the present multiple local agency wastewater management structure can be replaced by a single regional agency. This tends to equalize both cost and quality of service throughout the area. It also simplifies government structure and agency regulation.

Besides cost-effectiveness, geographic factors and regulatory constraints make regionalization desirable in northern Monterey County. The RWQCB prohibition of discharge to southern Monterey Bay limits the number of acceptable sites for ocean discharges. Also, the fact that Salinas Valley agricultural land offers the best potential for reuse of the large volume of wastewater produced in the study area makes centralization of treatment appear the most practical approach.

The advantages of regionalization include economy of scale in construction and operation, centralization of operation and maintenance responsibility, and the ability to integrate the solution of water quality problems for a given drainage area. One disadvantage of regionalization that is often mentioned by local entities stems from the requirement that local governments enter joint powers agreements, agreements that may extend local responsibility beyond individual member control. A perhaps more significant disadvantage is the increased magnitude of problems due to malfunction or breakdown of larger facilities.

Development of the Project Service Area

One of the initial tasks of planning for wastewater facilities in northern Monterey County was to identify the most logical service area for the regional project. The initial work in this regard was conducted by the Central Coastal RWQCB as part of their basin planning process. The Central Coastal basin plan (California State Water Resources Control Board, 1975a) identified several alternative means of treating and disposing of northern Monterey County's wastewater and made firm recommendations on which cities and communities should be considered for service. It also established a possible timing sequence for consolidation of wastewater treatment in the area.

The basin plan recommendations include as a first step, consolidation of the Pacific Grove and Monterey treatment systems with discharge through the existing Monterey outfall. A project to accomplish this is already out to bid. Subsequently, the plan recommends consolidation of wastewater flows from the Monterey plant, the Seaside plant, Ft. Ord, the Marina County Water District plant and the two Salinas plants for discharge through an outfall to central Monterey Bay. For the Castroville area, the basin plan suggests that it be tied to the new regional system once existing unsewered areas, including Moss Landing, Oak Hills and Prunedale, are sewered. As an interim step, it recommends transport of Moss Landing wastes to Castroville for a joint land disposal project, possibly to act as a demonstration of irrigation reuse potential. Small, unconsolidated residential areas around Salinas (Gabilan Acres-Oak Knolls and Toro Park) are encouraged to tie into the Salinas treatment system, thereby becoming part of the regional system.

These recommendations for consolidation of sewer service provided the major building block in establishing a service area for the north Monterey project. Within this framework, Engineering Science, Inc. conducted interviews with the area's public works and planning departments in order to identify likely directions of growth beyond existing sewered areas during the facilities planning period. Land use plans and records of septic tank problems were also reviewed. Finally, census tract data were used to identify population densities in rural areas; service area boundaries were then drawn to include existing served areas, rural areas of moderately high population density, developed areas with serious septic tank problems, and areas expected to be developed within the planning period to densities that could be economically serviced. Figure 2 shows the existing sewered area and the potential sewered area identified in this process; together they form the anticipated project service area.

Development of Alternatives

In June, 1975, Engineering Science, Inc. presented the first of a series of working papers to the Monterey Peninsula Water Pollution Control Agency, the title of this paper being "Alternative Courses of Action". In this working paper, 165 alternatives for regional wastewater management were discussed and presented schematically. Among these 165 alternatives, treatment facility locations ranged from one regional plant (to be generally located near Highway 1 and the Salinas River) to a regional plant with a number of outlying sub-regional plants, to maintaining and expanding all existing plants and not constructing a new regional facility. Combinations of these locations produced 14 location alternatives. Subsequently, eight additional system-wide alternatives increased the total to 173. It should be emphasized that regionalization means regionalized wastewater management in the most cost-effective manner, but not necessarily that all flow is contributed to a single regional treatment facility. The regionalization concept and the SWRCB's desire for its implementation are included in the basin plan for the Central Coast area (California State Water Resources Control Board, 1975a). This basin plan policy accounts for the emphasis given to regional systems in developing alternatives for the north Monterey area.

In combination with the various treatment facility locations, five methods for effluent reuse/disposal were considered. These reuse/disposal methods included:

1. Ocean Disposal - A new ocean outfall into Monterey Bay, originating near the mouth of the Salinas River and/or extension of the existing Marina Outfall.
2. River Disposal - Discharge to the lower Salinas River near the Highway 1 Bridge, and/or upstream near Salinas.
3. Unrestricted Irrigation - Irrigation of agricultural lands with no restriction on the method or rate of application (i.e. either flood, row or sprinkler irrigation) or the type of crop irrigated.
4. Groundwater Injection - Injection into the groundwater basin to form a seawater intrusion barrier.
5. Percolation/Irrigation Disposal - Percolation to the groundwater basin using percolation ponds or disposal by high-rate irrigation using special disposal sites (this can also function as partial treatment of wastewater).

Combinations of the treatment facility locations with various reuse/disposal concepts produced the aforementioned 173 alternatives. At a Technical Advisory Committee (TAC) meeting on June 27, 1975, detailed consideration was given to the many concepts utilized in the development of the initial 165 alternatives. Out of these deliberations, the TAC determined that the following concepts were infeasible, and should not be considered further:

1. The option of enlarging or upgrading treatment levels at each of the individual Monterey Peninsula treatment plants (Monterey, Seaside, Ft. Ord, Marina) in order to meet future discharge requirements was rejected. A key consideration in this decision was that if all treatment facilities were to discharge to a common

interceptor leading to a single reuse/disposal location, all effluent should receive a similar level of treatment. This would be difficult with multiple treatment plants. Also, if tertiary treatment were necessary, it should most logically be conducted at a central location where costs could be reduced. There was no appreciable difference in cost between conveyance of raw sewage and treated effluent.

2. Extension of the existing Marina Outfall for the purpose of serving only Marina was determined to be relatively expensive and infeasible. Extension of the outfall would be required by the RWQCB, as they have established a "no-discharge" zone landward of a line drawn between Point Pinos and the mouth of the Salinas River (see Figure 24). The Pacific Grove Marine Gardens Fish Refuge and the Hopkins Marine Life Refuge (designated as Areas of Special Biological Significance by the SWRCB) are located within this zone.
3. Tertiary level treatment at Castroville and the use of the effluent for local agricultural irrigation was determined to be infeasible by the project engineers. The principal basis for this decision was the high cost of treating a relatively small flow, and the necessity of using prime agricultural land for the plant expansion.

Based upon these decisions made at the June 27, 1975 TAC meeting, the number of remaining alternatives was narrowed to 45. Over the next three months, Jones and Stokes Associates, Inc., and their subcontractors worked with Engineering Science, Inc., to further narrow down the remaining 45 alternatives on the basis of both environmental and economic considerations. From an environmental standpoint, the major distinguishing characteristics between the remaining alternatives related to the method of reuse/disposal which would be used for the treated effluent. A matrix was prepared to evaluate the environmental impacts of various reuse/disposal options. The following impacts were considered in the matrix:

Potential Areas of Adverse Impacts

1. Soil quality
2. Salinas River flow
3. Ocean/estuarine water quality
4. Health hazard - land area
5. Health hazard - ground and surface water
6. Energy consumption
7. Aesthetics

Potential Areas of Beneficial Impacts

1. Groundwater supplies
2. Salinas River water quality
3. Ocean/estuarine water quality
4. Health hazard elimination - Salinas River
5. Salt water intrusion prevention
6. Water reuse

This matrix was extremely helpful in further narrowing the number of alternatives, but it was felt that this evaluation should not totally eliminate any major reuse/disposal option (land, ocean or river). The following additional decisions were also made during the screening process:

1. With the exception of the least expensive alternative, ocean disposal, any alternative must include at least some effluent reuse to receive further consideration.
2. Alternatives incorporating the Castroville Irrigation Project would only be retained if they utilized the entire amount of effluent from the study area during the irrigation season. This decision was made because utilization of less than the entire flow would probably prove uneconomical.

Other events during this three-month period included:

1. Development of three new alternatives based upon ideas developed by staff of member agencies.
2. Release of a preliminary draft report entitled, "Progress Report on Land Application of Wastewater in the Salinas/Monterey Bay Area". This report was prepared by Metcalf & Eddy Engineers under a contract with the U. S. Army Corps of Engineers. It identified three new alternative projects involving land application. These three alternatives utilized infiltration/percolation for disposal and/or long-term storage and were added to the list of remaining alternatives. A full draft of this report has since been released by the Corps of Engineers (Metcalf & Eddy Engineers, 1975).
3. Alternatives discussion and analysis at public workshops in Monterey (September 10, 1975) and Salinas (September 11, 1975).

Following the analysis of comments received at the public workshops, (which included strong support for beneficial reuse of wastewater) as well as the additional economic and environmental analyses conducted by Engineering Science, Inc., and Jones & Stokes Associates, Inc., the list of remaining alternatives was further narrowed to 21. These remaining alternatives were presented and discussed in a third Engineering Science Working Paper entitled "Apparent Best Alternatives", dated October 1975.

The general rationale which was utilized by the TAC in further screening of alternatives was as follows:

1. Alternatives which provided for utilization of only the City of Salinas effluent for agricultural irrigation were eliminated due to higher costs when compared to a regional system.

2. When two or more alternatives would have provided essentially the same benefits, the more costly alternative(s) were eliminated.
3. When two or more alternatives would cost the same and provide somewhat similar benefits, the alternative providing the highest environmental benefit was retained and the other(s) were dropped from further consideration.

At the October 31, 1975 TAC meeting, considerable discussion took place leading to a final screening of the alternatives down to 5. These remaining alternatives are briefly described below, using the numerical designations which were assigned to them during the screening process:

Alternative 1: Abandon all local plants, construct a regional secondary plant, and dispose of effluent through a new ocean outfall (see Appendix K for further explanation of treatment levels).

Alternative 134: Abandon all local plants, construct regional tertiary facilities, and discharge effluent to the Lower Salinas River in the nonirrigation season and reuse effluent for agricultural irrigation during the irrigation season. A surface storage reservoir would be constructed and used to store water while the *nitrification* system was being prepared for use (added in December 1975 working paper).

Alternative 166: Abandon all local plants, construct regional secondary and tertiary facilities, discharge secondary effluent to a new ocean outfall during non-irrigation months and use tertiary effluent for agricultural irrigation during the summer (major irrigation) months.

Alternative 170: Abandon all existing plants, construct regional secondary and tertiary facilities, and utilize all effluent for agricultural irrigation. A large surface storage pond would be constructed to store effluent during the non-irrigation season until it is required during the irrigation season.

Alternative 171: Abandon all existing treatment facilities, construct regional secondary and filtration facilities, and construct ponds to percolate effluent to the groundwater basin for storage. The stored water would be extracted by pumping, and utilized for subsequent agricultural irrigation.

The estimated costs of each of these alternatives are presented in Table 27.

Description of the Selected Alternatives

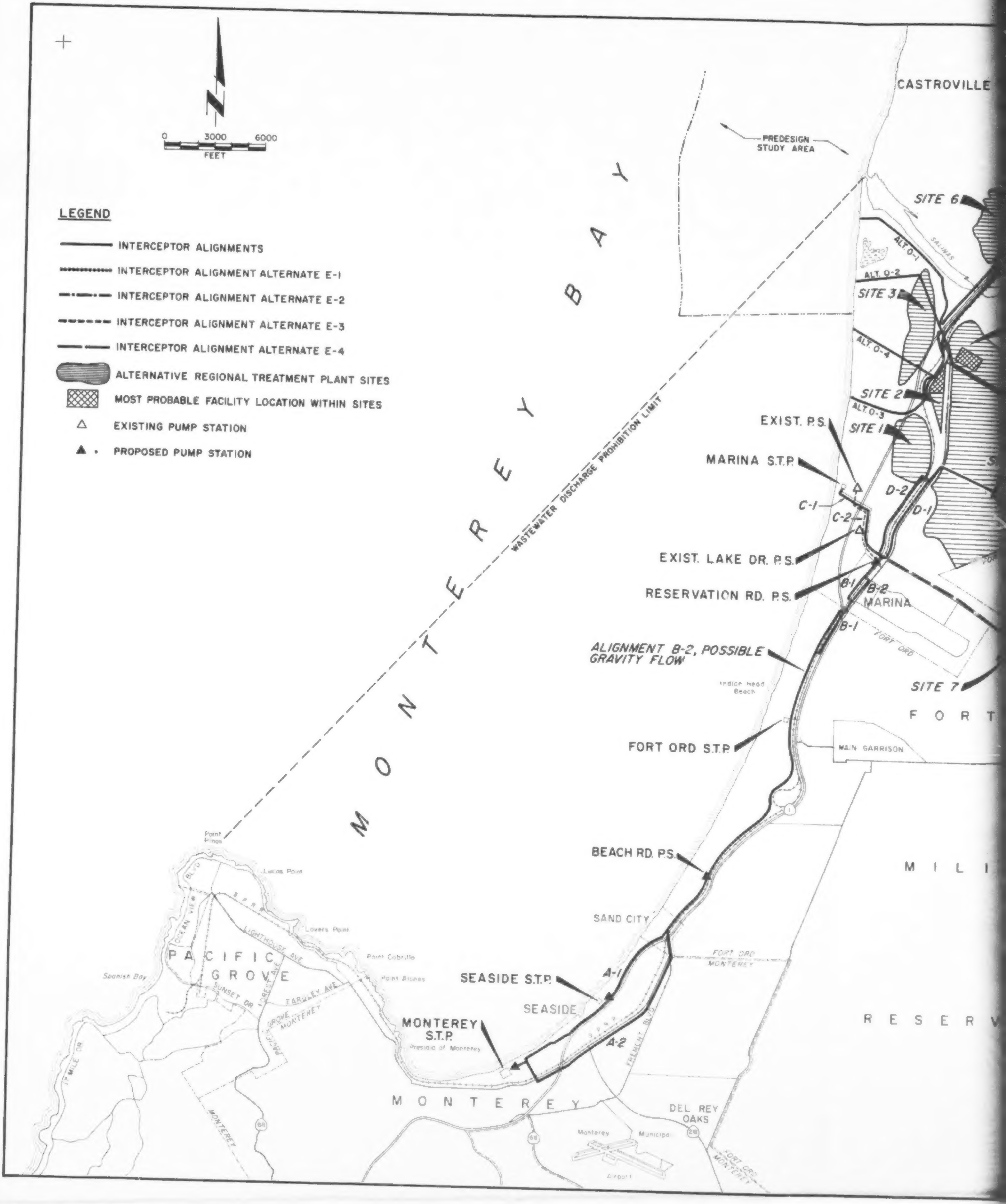
Facilities Common to All Alternatives

For the five selected alternatives, the location of the regional treatment facility and the location of the major interceptors conveying raw sewage to the regional treatment facility are identical. To avoid a substantial duplication in the discussion of the individual alternatives, as well as to increase clarity, facilities which are common to all alternatives are discussed in the following sections. The facilities are the same for each alternative because their location and size are not dependent on the ultimate treatment level or disposal/reuse option selected for implementation. The same area must be sewered and a treatment plant must be constructed regardless of which alternative is selected.

Location of the Regional Treatment Facility. Six possible locations were initially selected for further consideration as sites for a regional facility. These six locations (Figure 30) were selected using the following criteria:

1. The site should be compatible with surrounding land use.
2. The site should not be in an environmentally sensitive area.
3. The site should have sufficient area to allow for foreseeable future expansion.
4. The site should minimize energy requirements for conveyance of raw sewage to the site, and transportation of effluent to the disposal/reuse area.
5. The site should be as close to the area of reuse as possible for any alternative that includes effluent reuse.
6. The site should not be on prime agricultural land.
7. The site should be above, or be capable of protection from, a 100-year flood of the Salinas River.

Depending on the alternative eventually selected, and thus the level of treatment to be provided, the land area required will be between 40 and 50 acres. The land area, the present land use, and other characteristics of the potential sites are described in the Site Specific Environment section.

0
3000
6000
FEET
LEGEND
INTERCEPTOR ALIGNMENTS
INTERCEPTOR ALIGNMENT ALTERNATE E-1
INTERCEPTOR ALIGNMENT ALTERNATE E-2
INTERCEPTOR ALIGNMENT ALTERNATE E-3
INTERCEPTOR ALIGNMENT ALTERNATE E-4
ALTERNATIVE REGIONAL TREATMENT PLANT SITES
MOST PROBABLE FACILITY LOCATION WITHIN SITES
△ EXISTING PUMP STATION
▲ • PROPOSED PUMP STATION
CASTROVILLE
PREDESIGN STUDY AREA
MONTEREY BAY
WASTEWATER DISCHARGE PROHIBITION LIMIT
SITE 6
ALT. O-1
SALINAS
ALT. O-2
SITE 3
ALT. O-4
SITE 2
ALT. O-3
SITE 1
EXIST. P.S.
MARINA S.T.P.
C-1
C-2
D-2
D-1
EXIST. LAKE DR. P.S.
RESERVATION RD. P.S.
B-1
B-2
MARINA
FORT ORD
ALIGNMENT B-2, POSSIBLE GRAVITY FLOW
SITE 7
Indian Head Beach
FORT
FORT ORD S.T.P.
MAIN GARRISON
1
BEACH RD. P.S.
MILI
SAND CITY
FORT ORD
MONTEREY
A-1
SEASIDE S.T.P.
SEASIDE
A-2
RESERV
MONTEREY S.T.P.
Presidio of Monterey
S.P.R.R.
FREMONT BLVD
MONTEREY
DEL REY OAKS
Monterey Municipal Airport
FORT ORD MONTEREY
68
218
Point Pinos
Lucas Point
Lovers Point
Point Cabrillo
Point Alones
Spanish Bay
PACIFIC GROVE
OCEAN VIEW BLVD
LIGHTHOUSE AVE
FOREST AVE
SUNSET DR
FARLEY AVE
PACIFIC GROVE MONTEREY
17 MILE DR
MONTEREY

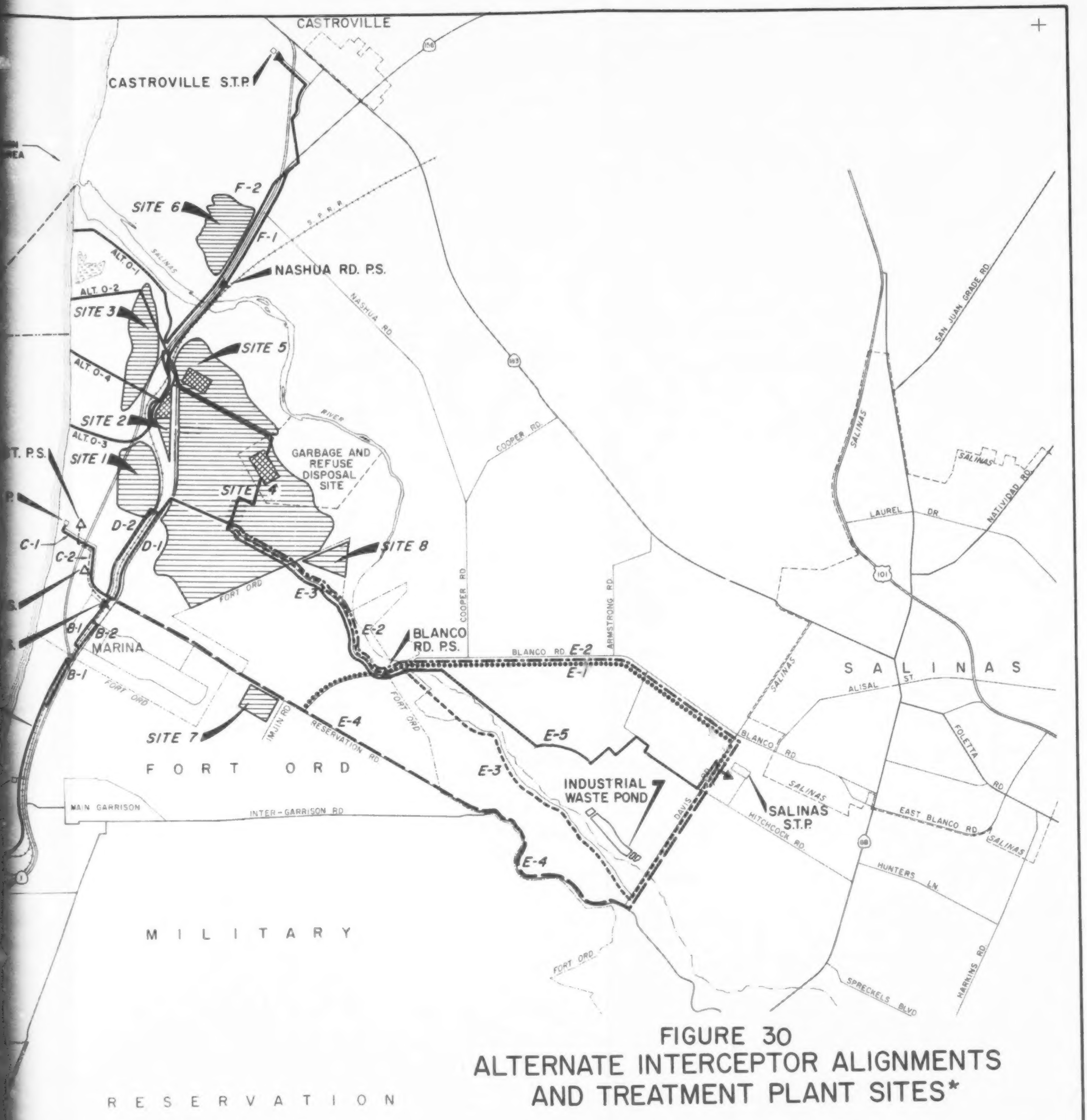


FIGURE 30
ALTERNATE INTERCEPTOR ALIGNMENTS AND TREATMENT PLANT SITES*

*MODIFIED FROM ENGINEERING-SCIENCE, INC. 1976

Table 27

ESTIMATED COST OF ALTERNATIVES**
(in millions of dollars)

Alternative	Capital Construction Cost (1975)	Operation and Maintenance Cost (1996)	Total Present Worth* (1975 $)
1 - ocean disposal	53.8	2.2	55.6
134 - irrigation/ river disposal (levels III & IV)	69.4	2.9	68.0
(levels V & IV)	77.1	3.4	73.4
166 - irrigation/ ocean disposal	64.7	2.4	60.1
170 - irrigation/ surface storage	82.0	2.7	71.2
171 - irrigation/ underground storage	51.5	2.4	53.5

* The number of dollars that would have to be invested in 1975 to construct and operate the project until 1995.

** Detailed breakdown in Appendix M, Table M-5.

Source: Engineering Science, Inc., pers. comm., 1976.

In a February, 1976, working paper (Engineering Science, Inc., 1976) the project engineers made a preliminary recommendation that Sites 2, 4 and 5 be given further detailed consideration and that the other three be dropped. Sites 3 and 6 occupy prime agricultural land and would be relatively unstable in the event of a major earthquake. They were therefore considered the least desirable for a treatment plant site. Site 1 is adjacent to the City of Marina and is likely to be developed in the near future. Therefore, it was recommended that this site also be dropped from detailed consideration. Sites 2, 4 and 5 are isolated from any significant developed areas and are supporting mainly extensive grazing operations at present. An added benefit of Sites 4 and 5 is that they have areas isolated from general public view. Site 4 was considered especially attractive in that the Marina landfill operation owns part of the site. The wastewater treatment and refuse disposal operations can be highly compatible land uses.

Subsequent to requests made at the February 1976, TAC meeting, two additional treatment plant sites were investigated by Engineering Science, Inc. (see Figure 31). The analysis was presented in the March 1976, working paper (Engineering Science, Inc., 1976b). The two sites were located on Ft. Ord property near the City of Marina. An economic evaluation of the sites by Engineering Science, Inc. and the fact that neither of these two sites appeared to provide an environmental advantage from their use when compared to the other six sites halted further consideration of their use.

Alignment of Major Interceptor Facilities. Consideration of interceptor alignment alternatives can be divided into six distinct segments, defined as follows:

Segment A - Existing City of Monterey treatment plant to Fort Ord treatment plant.
Segment B - Fort Ord treatment plant to Reservation Road in Marina.
Segment C - Marina Treatment Plant to junction with Segment B.
Segment D - Reservation Road to new regional facility.
Segment E - City of Salinas Main treatment plant to the new regional facility.
Segment F - Castroville Treatment Plant to new regional facility.

An interceptor that will transport Pacific Grove's wastewater to the Monterey treatment plant is already under design and will become a part of the regional interceptor system when the Monterey facility is eliminated.

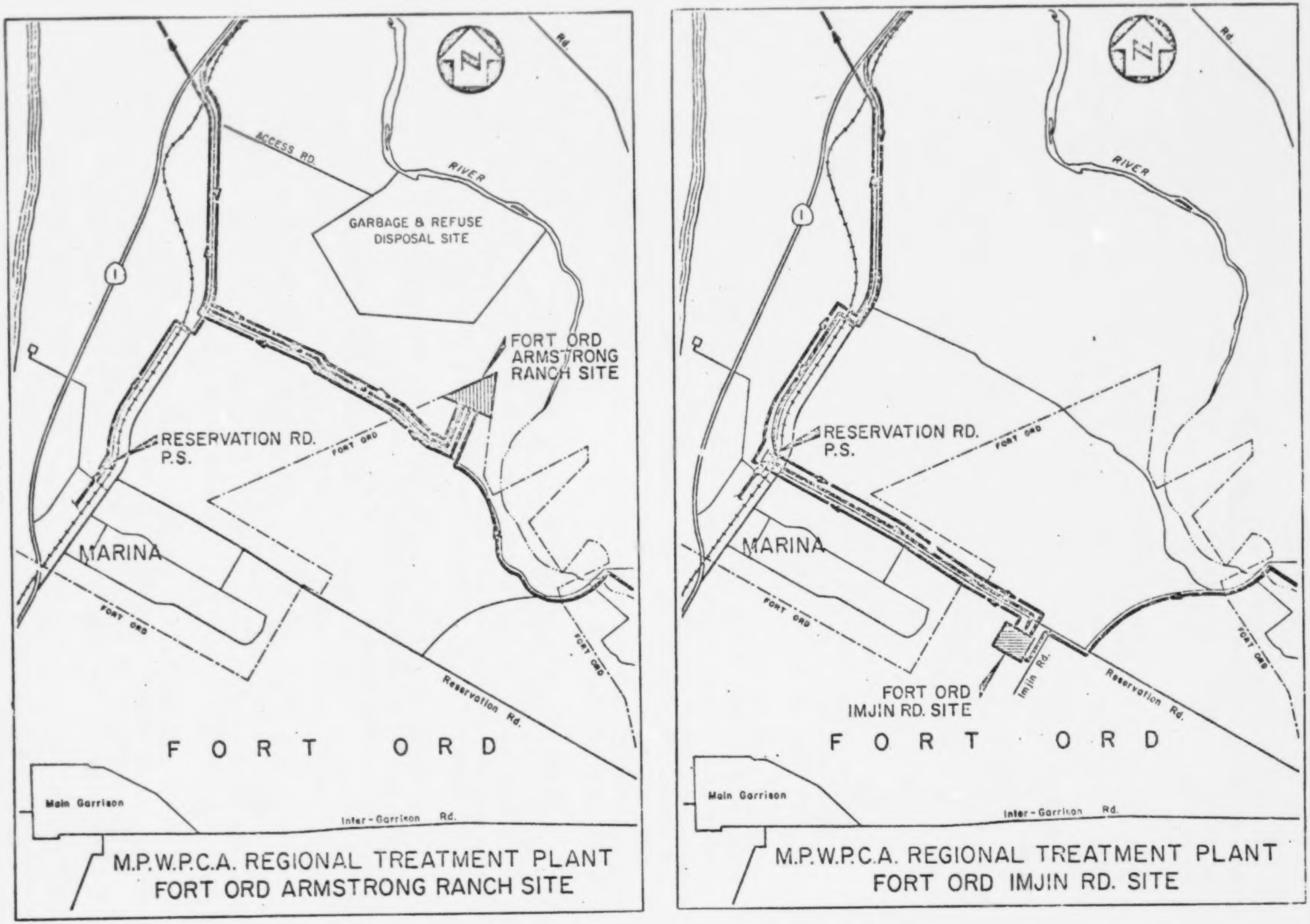


FIGURE 31 PROPOSED FORT ORD TREATMENT PLANT SITES
(SOURCE: ENGINEERING-SCIENCE, INC., 1976)

Within all but Segment C, a number of alternative alignments were considered possible, as shown in Figure 30. In order to aid in the choice of the best alignments, another working paper was prepared by Engineering Science, Inc., and Jones & Stokes Associates, Inc., entitled "Treatment Plant Sites and Interceptor Alignments (Engineering Science, Inc., 1976). This working paper presented detailed discussions of the monetary cost, engineering feasibility, and a variety of environmental impacts which could be expected from utilization of the various alignments.

At the February, 1976 TAC meeting, the various interceptor alignments were considered in detail; alignments A1, B2, C1, D2, E2; and F1 were recommended by ESI. Since that time, a new alignment from Salinas has been considered and is now the engineers (ESI) recommended route (E-5).

For purposes of comparing the interceptor alignments, it was originally assumed that the regional treatment plant would be located at treatment plant site No. 2. The present engineering recommendation is to use site No. 4. The numbers presented in Tables 28 and 29 that describe the various interceptor segments include routes to site No. 4 only. If other sites are eventually chosen for use, minor adjustments to lengths and routes will be necessary in the area between Marina and the Salinas River. The anticipated size, capacity and length of each interceptor segment is listed in Table 28. Anticipated location of pump stations is shown in Figure 26, and the energy requirements of the various interceptor systems are presented in Table 29. Brief route descriptions are as follows:

Monterey Sewage Treatment Plant to Fort Ord Sewage Treatment Plant. Alignment A-1 -- new Monterey pumping station -- northeastward along Front Street, Sand Dunes Drive, Tioga Avenue to the Southern Pacific Railway and Highway 1 frontage road, thence along Beach Range Road to the Fort Ord Sewage Treatment Plant.

Alignment A-2 -- new Monterey pumping station northeastward along Front Street and Sand Dunes Drive; southeast on Tioga Avenue to Del Monte Boulevard; northeastward on Del Monte, Southern Pacific Railway, Highway 1 and Beach Range Road to Fort Ord Sewage Treatment Plant (see Figure 30).

Fort Ord Sewage Treatment Plant to Reservation Road Pump Station. Alignment B-1 -- Fort Ord Sewage Treatment Plant northward on Beach Range Road, Highway 1 right-of-way and Marina Drive to new Reservation Road pump station (force main).

Alignment B-2 -- Gravity interceptor from Fort Ord Sewage Treatment Plant northward on Beach Range Road, Southern Pacific Railway right-of-way, Highway 1 right-of-way, Palm Avenue and Marina Drive to new Reservation Road pump station (see Figure 30).

Marina Sewage System to Reservation Road Pump Station. Alignment C-1 (interim treated effluent line) -- Marina Sewage Treatment Plant easterly and southerly in Reservation Road to new Reservation Road pump station. Alignment C-1 would be used only if a staged project is selected. The initial stage would include pumping treated effluent to a regional disposal site prior to construction of a regional treatment facility.

Alignment C-2 (raw sewage interceptor to be used when Marina plant abandoned) -- pump station east of Marina Sewage Treatment Plant southward to Reservation Road, thence south and eastward within existing lines to the new Reservation Road pump station (see Figure 30).

Reservation Road Pump Station to New Regional Sewage Treatment Plant. Alignment D-1 -- Reservation Road pump station northward in Highway 1 or Southern Pacific Railway right-of-way, thence eastward and northward in the Armstrong Ranch to the regional treatment plant site.

Alignment D-2 -- Reservation Road pump station northward in a Southern Pacific Railway right-of-way and Marina Drive to a junction with Alignment D-2 at the northern terminus of Marina Drive; thence in the same alignment as D-1 to the regional treatment plant.

Salinas Sewage Treatment Plant to the Regional Treatment Plant. Alignment E-1 -- Salinas Sewage Treatment Plant westward to Davis Road, north on Davis Road to Blanco Road, west on Blanco to Reservation Road, west on Reservation Road to Highway 1, and Reservation Road pump station.

Alignment E-2 -- Salinas Sewage Treatment Plant westward to Davis Road, north on Davis Road to Blanco Road, west on Blanco Road to a point 100 feet south of the Salinas River, thence westward and northward across Fort Ord and then Armstrong Ranch to the regional treatment plant site.

Alignment E-3 -- Salinas Sewage Treatment Plant westward to Davis Road, south on Davis Road to a point 150 feet south of the Salinas River, thence northwestward in a dirt service road paralleling the Salinas River to Blanco Road; southwest on Blanco Road for 800 feet, then westward and northward across Fort Ord and the Armstrong Ranch to the regional treatment plant site.

Alignment E-4 -- Salinas Sewage Treatment Plant westward to Davis Road, south on Davis Road to Reservation Road, thence west on Reservation Road to the new Reservation Road pump station.

Alignment E-5 -- Salinas Sewage Treatment Plant westward to Davis Road, south on Davis Road to Hitchcock Road, northwest on Hitchcock Road approximately 1 mile; thence westward along a dirt agricultural service road to Blanco Road immediately north of the Salinas River; southwest on Blanco Road to a point 200 feet south of the Salinas River, then west and north across Fort Ord and the Armstrong Ranch to the regional treatment plant site.

Castroville Sewage Treatment Plant to Regional Treatment Plant. Alignment F-1 -- Castroville Sewage Treatment Plant southeast to Preston Road; then southwest along State Highway 1 to the Marina landfill site service road; east on the service road to the regional treatment plant site.

Alignment F-2 -- Same as route F-1 except along the west side of State Highway 1 from Preston Road to the landfill service road.

Wastewater Treatment Process. The project's Facilities Plan (Engineering Science, Inc., 1976d) recommends activated sludge as the best secondary treatment process. Several processes were considered at the outset, including physical/chemical treatment, land treatment and biological treatment in confined reactors (activated sludge, trickling filter, etc.). The engineering analysis concluded that physical/chemical treatment required excessive energy and chemical inputs and would degrade the effluent quality, making reuse less feasible. Two of the three land treatment systems considered possible in the Salinas-Monterey area (crop irrigation and infiltration/percolation for later withdrawal and crop irrigation) would require secondary level pretreatment (Metcalf & Eddy Engineers, 1976) and therefore would not be an alternative to the engineer's recommended secondary treatment process. The third land system, overland flow, was considered too costly in terms of land requirements. Table 30 summarizes the general character of the most feasible alternative processes. The numbers presented are general in nature and could not necessarily be applied to a specific system in the study area.

Activated sludge systems generally require more energy and are more expensive than trickling filter or land treatment systems (excluding the cost of land), but they utilize less land and require fewer chemicals (primarily chlorine). An activated sludge system also provides a better level of treatment, reducing heavy metals and BOD more efficiently than trickling filters. The level of treatment can be adjusted in an activated sludge system by altering the retention time. Land application cannot be readily adjusted to improve treatment and poses the threat of groundwater contamination in areas with high groundwater table.

Table 28

DESCRIPTION OF ALTERNATIVE INTERCEPTORS

Alignment	Length* (feet)	Diameter (inches)	Design Peak Wet Weather Flow (mgd)	Design Year	Anticipated Design (Dry Weather) Average Flow Rate (mgd)***
A-1	8,000	24 - SCSD	30.9	Ultimate	10.5
	22,000	30 - Ft. Ord		↓	
A-2	11,300	20	30.9		10.5
	23,500	30			
B-1	10,200	30	38.9		13.7
B-2	10,200	48 (gravity)	38.9		13.7
C-1**	5,600	12	3.08		1.54
C-2**	3,800	6	1.4		--
	1,800	8	1.8		--
D-1	18,200	36	45.4		15.24
D-2	18,200	36	45.4		15.24
E-1	41,800	36	27.3	2,000	13.07
E-2	45,000	36	↓	↓	13.07
E-3	50,500	36			13.07
E-4	44,800	36			13.07
E-5	39,000	36			13.07
F-1	23,000	12	3.6		1.56
F-2	23,200	12	3.6		1.56

* Assumes treatment plant located on Site 4.

** There are no alternate alignments; C-1 is alignment required for treated effluent and C-2 is alignment required after Marina Sewage Treatment Plant is abandoned.

*** Based on observed per capita flow rates and projected population.

Source: Engineering Science, Inc., pers. comm.

Table 29

ENERGY REQUIREMENTS OF INTERCEPTOR ALTERNATIVES

Alignment*	Number of Pump Stations	Estimated Annual Kwh Consumption Pumping Raw Sewage 1980	2000
A-1**	2	2,590,000	4,102,000
A-2	2	2,626,000	4,223,000
B-1	1	479,000	782,000
B-2**	Gravity		
C-1**	Gravity	---	---
C-2**	1	---	---
D-1	1	2,862,000	3,962,000
D-2**	1	2,862,000	3,962,000
E-1	2	4,893,000	8,549,000
E-2	1	2,221,000	3,871,000
E-3	1	2,246,000	3,962,000
E-4	2	5,863,000	10,094,000
E-5**	1	2,200,000	3,800,000
F-1**	2	153,000	644,000
F-2	2	153,000	644,000

* Assumes treatment plant located on Site 4.
** Alignment recommended in Draft Facilities Plan.

Source: Engineering Science, Inc., pers. comm.

Table 30

COMPARISON OF ALTERNATIVE TREATMENT PROCESSES

	Physical/ Chemical[1]	Biological		Land Treatment[2]
		Activated Sludge	Trickling Filter	
Land requirements (acres/mgd)[3]	9	19	20	540[4]
Energy requirements (Kwh/day)	9,680	5,004	3,044	1,270
Personnel requirements (man years/year)	15.1	11.1	6.2	5.5
Chemical requirements (pounds/day	21,000 lime; 21 polymer; 26,500 CO_2 3,885 C 420 chlorine	670 chlorine	840 chlorine	840 chlorine
Capital costs	$4,100,000	$4,110,000	$3,810,000	$2,210,000[5]
Operating costs (cents/1,000 gallons	14.5	7.4	6	4

---

[1] Coagulation, filtration, carbon adsorption.

[2] Overland flow - other methods (crop irrigation and infiltration-percolation with recovery for crop irrigation) would require secondary pretreatment or would require a larger land area than is available in the study area (Metcalf & Eddy Engineers, 1976).

[3] Includes land for treatment plant and liquid disposal (not for sludge treatment or disposal).

[4] From Metcalf & Eddy, 1976.

[5] Does not include cost of acquiring land for liquid disposal.

Source: Battelle Memorial Institute, 1974. All figures for a 10 mgd treatment plant.

There are also alternatives to the conventional tertiary treatment processes being proposed for the irrigation alternatives -- 134, 166 and 170. Predesign of the tertiary facilities has not been completed, but system costs to date have assumed use of *chemical coagulation*, sedimentation, filtration and chlorine disinfection in order to achieve treatment beyond secondary requirements. Ozonation, a relatively new process, has been tested and utilized as an alternative to conventional tertiary treatment. Tests conducted for the Chino Basin Municipal Water District in Orange County, California by James M. Montgomery, Consulting Engineers, showed that ozonation of secondary effluent from an activated sludge system is capable of producing an effluent quality at least as good as standard tertiary treatment with significantly better virus removal (James M. Montgomery, Consulting Engineers, Inc., 1975). The small-scale prototype tested also required considerably fewer chemicals (i.e., alum and chlorine). Energy requirements, however, were significantly higher. Further investigation of the success of ozonation may be desirable prior to making final recommendations for disinfection at the regional plant.

The engineer's proposed method of processing the sludge includes dissolved air flotation thickening and anaerobic digestion. The necessity of subsequent dewatering depends on the outcome of the sludge disposal study being conducted by the project engineers. The additional study seeks to identify environmentally and economically feasible alternatives to standard dewatering methods, i.e., vacuum filtration, filter presses, air driers, heat treatment. (Filter presses are the only feasible method of meeting the current discharge requirements of disposing of sludge in a sanitary landfill.) These standard methods generally require large energy and/or chemical inputs. The close proximity of the Marina landfill to the proposed regional treatment plant makes it worthwhile to investigate less costly landfill dewatering-disposal schemes.

Sludge Processing and Disposal Alternatives. The sludge disposal process to be used by the regional treatment plant is yet to be determined. The Facilities Plan engineers are investigating at least three alternative methods of sludge dewatering and disposal in greater depth than is recorded in the Facilities Plan draft. These include: 1) use of the absorptive capacity of incoming solid wastes at the Marina landfill; 2) use of the moisture-holding capacity of the soils in the vicinity of the Marina landfill; and 3) provision of drains under the Marina landfill and disposal of undewatered sludge in the landfill. All three are land disposal techniques.

Table 31 on the following page compares several different sludge processing methods in terms of resource requirements. The information is generalized, reflecting only relative needs for each system. If applied to a specific wastewater system (i.e., the Monterey regional plant), the numbers could vary considerably.

The flotation-digestion-land spreading system being considered in detail by the project engineers has a low capital and operating cost and a low energy requirement. The proposed use of methane gas generated by the digestion process further increases the system's energy efficiency. The only potential shortcomings of the process appear to be the relatively large land and personnel requirements. The extra personnel would be needed to carry out the sludge spreading. Land availability in the vicinity of the proposed regional treatment plant is good at present, but further consideration of costs associated with use of the land is necessary before judging the feasibility of the proposal.

The proposed land spreading-landfilling disposal of sludge in the Class II Marina site has several potential environmental problems associated with it. The major concerns are impacts on surface and groundwater quality. If the sludge has a low solids content (less than 50 percent), which is highly likely, the RWQCB may require catchment of all overland runoff from the landfill site in order to avoid water quality degradation of the Salinas River. The high moisture content of the sludge could also lead to groundwater contamination. An extensive geohydrologic investigation of the landfill substrate would be necessary to define this threat.

There are numerous other methods available for disposal of sludge. Two reuse options that exist are soil conditioning and co-disposal with solid waste through incineration or pyrolysis. The soil conditioning option is not precluded by land spreading. If a demand exists for this use, the materials could be trucked away prior to spreading. Co-disposal could produce energy and initiate total sludge reuse, but the energy may not be needed at the plant site. The possibility of using methane gas for operating the entire treatment system is being investigated by the plant designers, Engineering Science, Inc. The location of the landfill and proposed location for the treatment plant are relatively remote from other potential users of energy generated by co-disposal. A cost-benefit comparison would have to be made to determine the desirability of supplying the generated energy to the Marina or Castroville areas or possibly to PG&E, the major energy supplier in the area.

Table 31

COMPARISON OF ALTERNATIVE SLUDGE PROCESSING METHODS

	Flotation, Digestion, Land Spreading*	Chemical Conditioning Centrifugation	Flotation, Digestion, Sand Drying	Flotation, Chemical Conditioning, Vacuum Filtration
Energy requirements (units/day)	220 Kwh	1,862 Kwh	220 Kwh	2,003 Kwh
Chemicals (pounds/day)	12-58	45-55	11-58	192-268
Land (acres)	60-260	4.1-5.5	13.7-15.4	4.3-5.8
Personnel (man years/year)	10.2-13.9	4.1-5.8	3.4-7.9	5.6-7.5
Sludge total dry weight (pounds/day)	14,000	6,990**	14,000	6,990**
Capital cost	$300,000-400,000	$1,200,000-1,300,000	$570,000-640,000	$1,000,000-1,300,000
Operating cost (cents/1,000 gallons)	2.6-2.9	3.15-4.85	3.1-4.1	4.6-7.0

* Process currently being considered in detail by the project engineers.
** Does not include centrate recycled through treatment plant.

Source: Battelle Memorial Institute, 1973. All figures are for a 10 mgd activated sludge treatment system.

Other methods of sludge disposal include incineration, spreading on soil, lagooning and ocean discharge. Incineration and ocean discharge fail to reuse any portion of the sludge. In addition, incineration requires an energy input and results in emission of air contaminants. Ocean discharge of sludge is prohibited by the SWRCB (1975a) and EPA. Lagooning requires a significant acreage of land and has adverse visual and odor impacts. It does not preclude reuse of the sludge, but the process of stripping the sludge deposit from the bottom of the lagoon would occur on an infrequent basis and would require a significant labor and equipment input.

Disinfection. The recommended wastewater disinfection method included in the Facilities Plan is *chlorination*. Chlorine dosage should range between 5-15 mg/l (Engineering Science, Inc., 1976b). Chlorination would be followed by dechlorination with SO_2 at a dosage rate of 2-5 mg/l. Other methods of disinfection have been considered, including ozonation and several types of radiation. The technology involved with these processes is still experimental and it remains to be seen how effective and reliable these alternatives are on a long-term basis. The engineer's recommended treatment system does not include filtration, thereby making it difficult to maintain proper disinfection with ozone. Ozonation also requires a relatively large energy input (Engineering Science, Inc., pers. comm.).

The Alternative Treatment and Disposal Systems

In this section, the five treatment and disposal alternatives are discussed in detail. The discussions describe facilities which would be required and how they would be operated. To make the description more comprehensible, the various levels of treatment are described only as secondary or tertiary. (Should the reader desire a more complete description of treatment process, he is referred to Appendix K.)

Alternative I. Alternative I includes regional treatment followed by ocean disposal via a deep ocean outfall. All of the existing treatment facilities would be abandoned except pumping facilities at the Monterey, Salinas, Seaside and Castroville plants, and the previously discussed interceptor system would convey raw sewage to the regional treatment facility. Septic tank and chemical toilet pumpage may be trucked to the site. This possibility is receiving further consideration by the project engineers. The new regional facility would provide Level I-A secondary treatment (see Appendix K), and would have an initial design capacity of 25.4 mgd. The initial construction of treatment facilities would require 14 acres of land out of the 30 acres ultimately required. Design flows for all alternatives are shown in Table 32.

Table 32

TREATMENT AND DISPOSAL SYSTEM DESIGN WASTEWATER FLOWS

Tributary Area	1990 Avg (1) Dry Weather Flow mgd	1990 Peak Dry Weather Flow mgd	Infiltration/ (2) Inflow to be Treated, mgd	1990 Peak Wet (3) Weather Flow mgd	Ultimate Avg (1) Dry Weather Flow mgd	Ultimate Peak Dry Weather Flow mgd	Ultimate Peak (3) Wet Weather Flow mgd
Monterey Peninsula Communities	13.02	23.88	14.73	38.61	15.24	27.13	41.86
Salinas Area	11.23	17.52	7.34	24.86	22.00	33.00	40.34
Castroville Area	1.16	2.38	0.59	2.97	1.87	3.48	4.07
TOTALS	25.41	43.78	22.66	66.44	39.11	63.61	86.27

(1) From Table III-7
(2) From Table IX-1, estimated from I/I analysis data. SSES work may result in changes.
(3) Equals peak dry weather flow plus infiltration/inflow.

Source: Engineering Science, Inc., pers. comm.

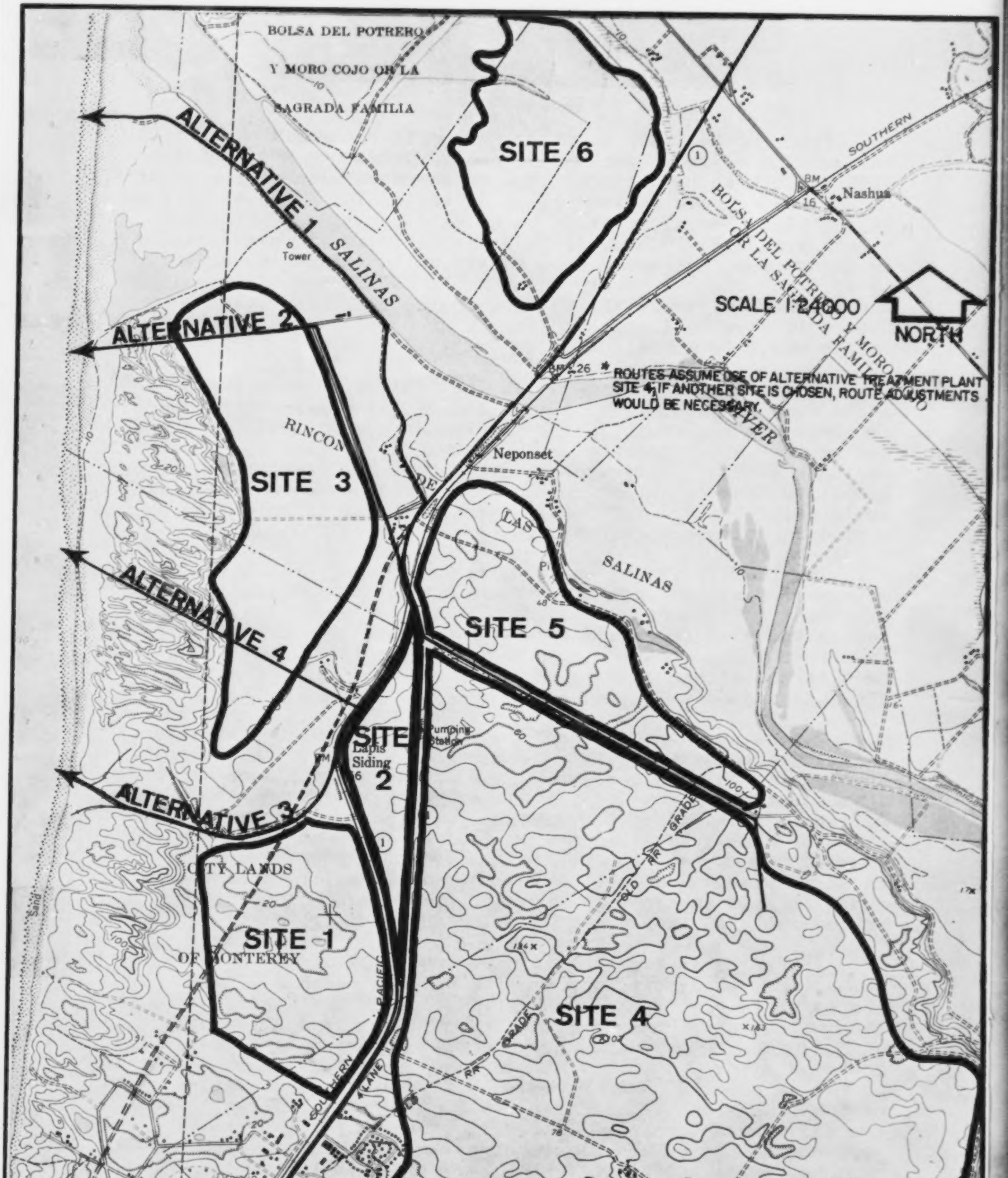
From the regional facility, the effluent would be carried through the on-shore portion of ocean outfall to its junction with the off-shore portion. The on-shore portion of the ocean outfall would have a diameter of 54 inches and a length of from 14,200 feet (for alternative route 0-4) to 19,000 feet (for alternative 0-1). These lengths assume treatment plant Site 4 is used. The pipe would have a peak wet weather flow capacity of 87 mgd. The on-shore portion would follow one of the alignments shown in Figure 32, again assuming treatment plant Site 4 is used. If another site is eventually selected, the routes would be modified.

The off-shore portion of the outfall would have a diameter of 54 inches, be at least 6,400 feet (1,950 meters) long, and terminate at a depth of at least 72 feet (22 meters). The peak wet weather flow capacity of the off-shore portion of the outfall would be 87 mgd. Ultimate outfall length and depth have not been finalized, as some question remains regarding the acceptability of anticipated initial dilutions of the effluent plume at the engineer's proposed diffuser terminus.

The facilities engineers have recommended use of a southern alignment for the offshore portion of the ocean outfall. This alignment is further removed from Monterey Canyon than other routes analyzed and the engineers feel that the current patterns in the southern area are such that greater initial dilutions can be obtained within a range of practicable diffuser lengths (Engineering Science, Inc., 1976f).

Depending upon construction time schedules, useful life of existing treatment facilities, and a variety of other factors, implementation of Alternative 1 might possibly be accomplished in stages. If so, the major interceptors and the on-shore and off-shore portions of the outfall would be constructed first, allowing mid-bay discharge of secondary effluent from existing plants. Then, when the new regional facility was completed, existing plants would be abandoned and the major interceptors would be used to carry raw sewage to the regional plant, which would discharge treated effluent to the outfall.

Figure 33 is a schematic representation of the Alternative 1 collection, treatment, and disposal system. Table 27 presents the costs, Table 33 the energy requirements and Table 34 the chemical requirements of Alternative 1 and the other project alternatives. The energy numbers are presented in kilowatt hours of electricity, but much of the power demand would actually be met by burning methane produced in the sludge digestion process. The anticipated service lives of the new facilities for all alternatives are listed in Table 35. The schematic representations of the alternatives have been drawn assuming a regional treatment plant at Site 4. If another site is chosen, the pipelines will follow slightly different routes north of Marina.



* ROUTES ASSUME USE OF ALTERNATIVE TREATMENT PLANT SITE 4, IF ANOTHER SITE IS CHOSEN, ROUTE ADJUSTMENTS WOULD BE NECESSARY.

FIGURE 32 ALTERNATIVE OCEAN OUTFALL ALIGNMENTS*

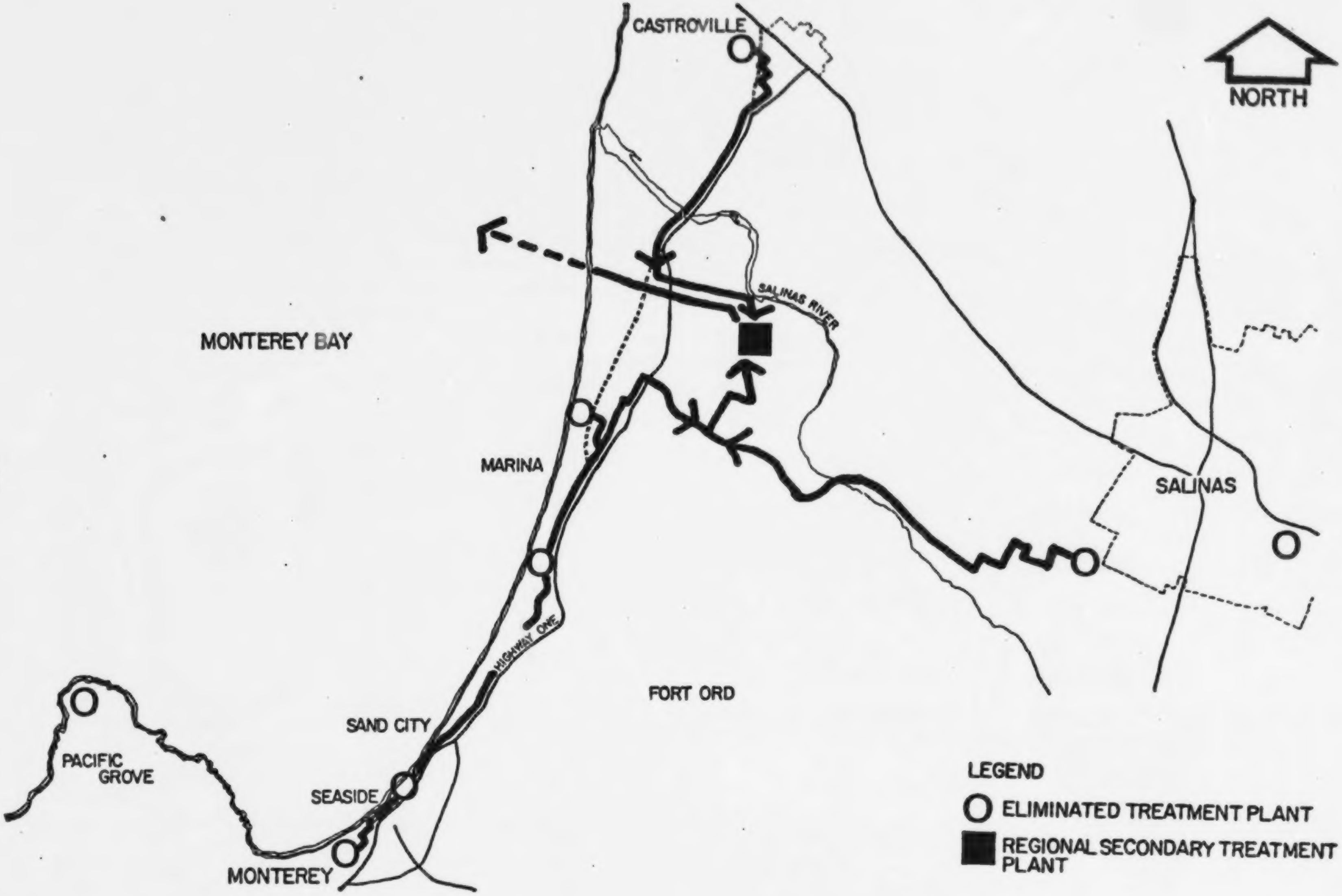


FIGURE 33 ALTERNATIVE I
OCEAN DISPOSAL

Table 33

ANTICIPATED ENERGY REQUIREMENTS OF WASTEWATER SYSTEM ALTERNATIVES[1]

Alternative Number	Treatment Levels[2]	Annual Kwh Utilized, 1980			Annual Kwh Utilized, 2000		
		Collection[3]	Treatment	Disposal	Collection[3]	Treatment	Disposal
1	1A	7,826,000	6,404,000	0	12,579,000	9,853,000	0
134	III or V & IV[4]	7,826,000	8,987,000	0	12,579,000	13,826,000	0
166	IB & IV	7,826,000	6,867,000	0	12,579,000	10,564,000	0
170	IB & IV	7,826,000	6,867,000	0	12,579,000	10,564,000	0
171	II	7,826,000	6,731,000	–[5]	12,579,000	10,355,000	1,900,000

[1] Energy requirements of construction discussed in the impact section; the numbers in the table do not reflect the proposed use of methane to operate treatment plant facilities; methane from sludge digestion may eventually supply total energy needed to operate treatment plant.

[2] See Appendix K for explanation.

[3] Assumes engineer's recommended alignments and treatment plant located at Site 4 (does not include energy consumed by existing collector systems).

[4] If level V required for six months per year, increase power requirements by 91,500 Kwh in 1980 and by 140,800 Kwh in 2000.

[5] No requirement in 1980 because irrigation project probably will not begin until 1987.

Source: Engineering Science, Inc., pers. comm.

Table 34

ANTICIPATED CHEMICAL REQUIREMENTS OF WASTEWATER SYSTEM ALTERNATIVES (pounds per year)

Alternative Number	Chlorine		Other Chemicals*	
	1980	2000	1980	2000
1	304,400	456,600	540,200	810,300
134	608,800	913,200	609,000	913,500
166	608,800	913,200	609,000	913,500
170	608,800	913,200	609,000	913,500
171	608,800	913,200	540,200	810,300

* Includes lime, alum, ferric chloride, and sulphur dioxide.

Source: Engineering Science, Inc., pers. comm.

Table 35

SERVICE LIVES OF NEW FACILITIES

Unit	Percentage of unit	Service Life, years
Pipelines and ocean outfalls	100	50
Pumping stations	66	30
	34	15
Primary, secondary and tertiary unit processes; chlorination, including sewage sludge handling	40	35
	60	20

Source: Engineering Science, Inc., 1976d.

Alternative 134. Alternative 134 includes both irrigation reuse of wastewater and discharge to the lower Salinas River. Because some controversy has developed over the level of treatment required for discharge to the lower river, two versions of this alternative are being analyzed. The first version includes two stages: 1) Construction of regional interceptors and a level III regional treatment plant for year-round discharge to the lower Salinas River while an agricultural demonstration project (described below) is in progress. 2) In the second stage, should irrigation reuse prove feasible, additional treatment facilities would be constructed at the regional plant and level IV effluent would be piped to the Castroville area for irrigation as demand dictated. During non-irrigation months, level III effluent would be discharged to the lagoon. If irrigation reuse proved infeasible in the agricultural demonstration project, the year-round discharge to the lagoon would continue indefinitely. The second analysis of Alternative 134 will be exactly as above, except treatment level V will be substituted for level III in periods of low flow (less than 10 to 1 natural flow to effluent dilution ratio) discharge to the lagoon. In both cases, all existing treatment facilities would eventually be abandoned, and the previously discussed interceptor system would convey raw sewage to the new regional treatment facility.

First stage facilities (level III or V) would have an initial design capacity of 26 mgd, and would require about 14 acres of land. Second stage facilities (level IV) would have a capacity of 26 mgd, and would require approximately 10 additional acres of land.

At the end of the growing season it would be necessary to acclimate the nitrification system for both levels III and V treatment. This process takes about 2 weeks, so a storage facility would be needed to hold the inadequately nitrified wastewater prior to recycling through the plant. The storage reservoir would be located in the vicinity of the treatment plant if possible. About 120 acres would be occupied, and the reservoir would be about 10 feet deep. It would therefore be capable of holding a full two weeks flow of effluent. Construction would be by excavation with the excavated material being used to construct a dike around the reservoir. To prevent percolation of effluent, the reservoir would be lined with plastic or clay.

Level IV treatment would be provided prior to storage. After this treatment, the effluent would flow by gravity to the storage reservoir. This same pipeline would also be used as a force main to pump the water back to the plant for further treatment prior to delivery to farmers. The alignment of the pipeline and the location of the storage reservoir have not yet been determined.

During the irrigation season, tertiary effluent would be pumped from the treatment plant to an irrigation distribution system. A gravity pipeline 36 inches in diameter would be required. When irrigation demands exceed plant inflow, water in the storage reservoir would be returned to the plant, be treated to level IV, and then delivered to the irrigation area. The general alignment of the delivery pipeline to the Castroville area is shown in Figure 34. (The exact route has not been determined.)

During the non-irrigation season, disinfected level III or V effluent would flow by gravity from the regional treatment plant to the lower Salinas River in a 54-inch diameter pipeline. Peak wet weather flow capacity would be 87 mgd. Alignment of this outfall would be generally as shown in Figure 34.

An irrigation demonstration project is being proposed as part of all irrigation reuse alternatives to determine the feasibility of irrigating Salinas Valley food crops with wastewater from a regional treatment plant. The program being developed by Engineering Sciences, Inc. would seek to answer public health, soil and crop damage, and marketability questions specific to the lower Salinas Valley area. (The technical approach of the demonstration project is described in Appendix L). It would encompass 20 to 40 acres of leased land, preferably with Pacheco soils. Four water types and two crop types would be used to properly anticipate the effects of the proposed regional irrigation project. A specific location has not been selected. This demonstration would be started during the initial stage of the overall project and would be expected to last from 2 to 5 years. Construction of the full tertiary facilities and delivery system to the irrigation area would be dependent on the results of the demonstration project. If the demonstration project was successful and a significant demand for the wastewater developed, storage facilities could be added to Alternative 134 so that some or all of the winter wastewater flows could be held for irrigation use in the spring and summer months.

Figure 34 illustrates the Alternative 134 collection, treatment and reuse/disposal system.

If irrigation of food crops proved undesirable in the lower Salinas Valley, discharge to the lower river could continue or other methods of reuse could be investigated. This might include irrigation of feed, fodder or processed food crops, deep well injection as a salt water barrier, or irrigation of parks and landscaped areas. These methods of reuse have been given some early consideration, but are considered of lower priority for a variety of reasons.

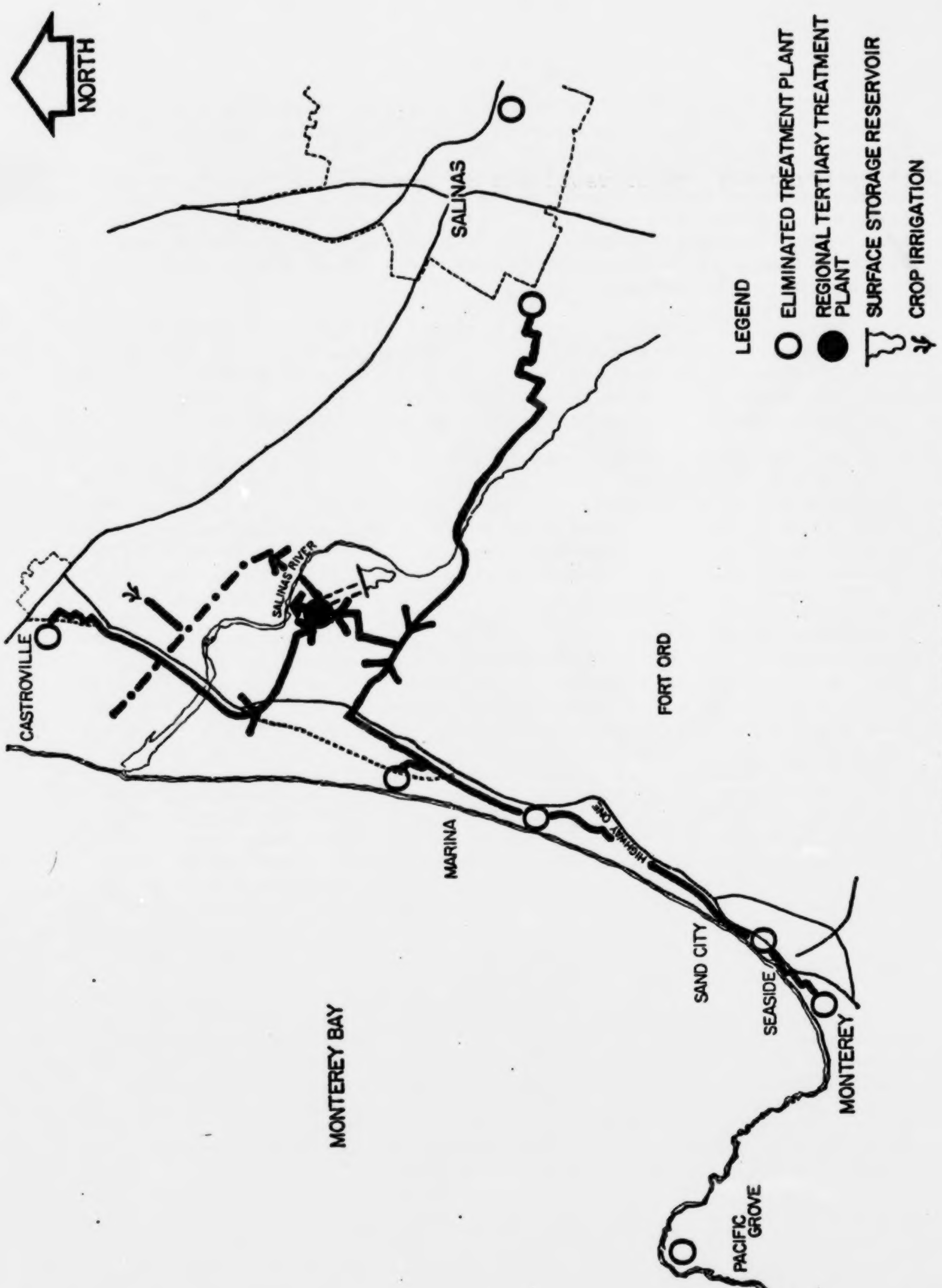


FIGURE 34 ALTERNATIVE 134
CROP IRRIGATION/RIVER DISPOSAL

Generally, food crop irrigation would maximize benefits by providing for an existing water need rather than creating a new water demand. There are no significant areas of feed, fodder or processed food crop production near the proposed treatment plant site. In order to utilize the wastewater on this type of crop, it would have to be piped a considerable distance to existing acreage or the rolling grassland north of Marina would have to be converted to irrigated cropland. Irrigating new crop areas would not help alleviate the groundwater overdrafting taking place in the lower Salinas Valley; and piping to existing fodder or processed food crop areas would require large capital and energy inputs.

Aquifer injection of wastewater as a barrier to sea water intrusion in the lower Salinas Valley was given early consideration by project engineers. In their August, 1975 working paper (Engineering Science, Inc., 1975b), several shortcomings to this reuse option were listed. These included: injection of all the region's wastewater in 1995 would balance only 50 to 60 percent of the 180- and 400-foot aquifer net withdrawals -- this would not prevent salt water intrusion; if the Castroville Irrigation Project were to proceed, the injection would be a partially-redundant effort to halt intrusion; the added cost of improving treatment and installing and operating injection wells would probably mean costs would be approximately 50 percent higher than tying into the CIP for reuse. For these reasons, the engineers recommended that the injection option not be considered further.

The California Department of Health has authority to regulate deep well (waste well) injection of reclaimed wastewater (Porter Cologne Water Quality Control Act, Chapter 7, Article 6, Section 13540). To date, they have not adopted specific injection regulations, but are considering proposals on a case-by-case basis (Spath, pers. comm.). The principal health-related concern is protection of water-bearing strata that are or may be suitable for use as a domestic water supply. There is currently only one waste well injection project in operation in California -- Water Factory 21 in Orange County. The wastewater is being used as a barrier to sea water intrusion.

Irrigation of parks and landscaped areas is also a reuse possibility. Fort Ord is already initiating a landscape irrigation reuse program. Similar projects could be started at any of the existing wastewater treatment facilities if full reuse of crop irrigation is not initiated at the regional treatment plant.

Alternative 166. Alternative 166 includes regional treatment followed by use of tertiary effluent for irrigation and discharge of secondary effluent to the ocean during non-irrigation months. All existing treatment facilities would be abandoned, and the previously discussed interceptor system would convey raw sewage to the new regional facility.

Secondary treatment facilities would be identical to those discussed for Alternative 1, and tertiary facilities would be identical to the second stage level IV facilities discussed for Alternative 134. Initial land area required would be 14 acres, with an ultimate acreage of 30.

On-shore and off-shore outfall facilities for ocean disposal would be identical to those described in Alternative 1, (Figure 33). The pipeline to the irrigation area would be similar to that described for Alternative 134 (Figure 34), except that a small storage pond (40 acre-feet on 4 acres of land) would be used to balance daily irrigation demands with available effluent.

As with Alternative 1, construction of Alternative 166 could be staged. If major interceptors and the on-shore and off-shore portions of the ocean outfall were completed, they could be utilized to convey secondary effluent from existing plants to mid-Bay disposal. Upon completion of the regional secondary treatment facility, all existing plants could be abandoned and the major interceptors could then be used to carry raw sewage. The agricultural demonstration project described in Alternative 134 would also be part of Alternative 166. Tertiary facilities would be built only after the demonstration project proved wastewater irrigation of food crops feasible. If irrigation demand subsequently became great enough, wastewater storage facilities could be constructed to store winter flows and increase the total amount of wastewater available for reuse. If irrigation was found to be infeasible, ocean discharge and/or some other reuse would continue.

Figure 35 illustrates the Alternative 166 collection, treatment and reuse of disposal system.

Alternative 170. Alternative 170 includes regional treatment with reuse of all of the treated effluent for crop irrigation in the Castroville area. All existing treatment facilities would be abandoned and the previously discussed interceptor system would convey raw sewage to the regional plant. Because tertiary effluent can only be used during the irrigation season, substantial storage would have to be provided to store winter flows. The treatment and storage concepts are described in the following sections.

The treatment process to be utilized in Alternative 170 is actually a treatment-storage-treatment system. Storage is provided as an intermediate stage within the treatment process for extremely important reasons.

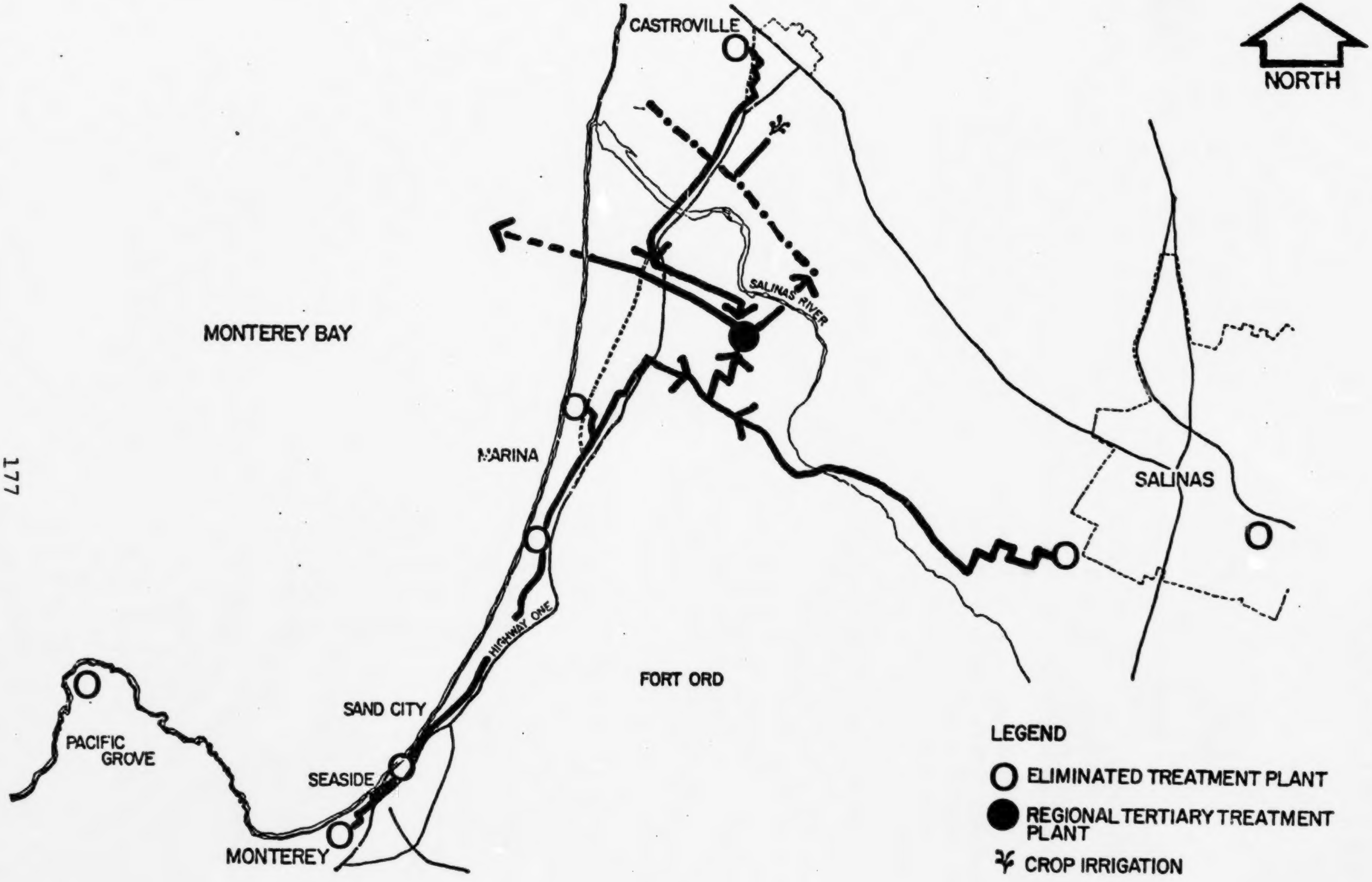


FIGURE 35 ALTERNATIVE 166
CROP IRRIGATION/OCEAN DISPOSAL

1. Raw wastewater cannot be stored for an extended period of time without production of noxious odors. In addition to odor production, large floating masses of green algae would soon appear across the pond surface. The combination of these two conditions would be undesirable.
2. High quality tertiary effluent cannot be stored for an extended time period either because a slight amount of algae growth is possible, a condition which would make the water unsuitable for irrigation use.

Provision of the intermediate storage dictates that the treatment facilities preceding the storage be sized based upon flow into the regional facilities, and that treatment facilities following the storage be sized according to peak irrigation demands.

Prior to storage, secondary treatment and filtration (level II - Appendix K) facilities having an initial design capacity of 26 mgd would be constructed. Following filtration, the effluent would be pumped through a 54-inch diameter force main to a presently undetermined location. Storage facilities would probably be located in the area mapped in Figure 36, covering a surface area of roughly 900 acres, and would be capable of storing about 9,000 acre-feet of water. Excavation and sealing of the storage facility would be similar to that described for Alternative 134.

Stored secondary/filtered wastewater would be returned to the regional treatment facility by gravity flow through the same pipeline used to pump wastewater to the storage reservoir. Irrigation requirements would dictate time and rate of return. Tertiary treatment would be performed prior to delivery to the irrigation area. Fifteen acres of land would be required for the initial treatment facilities with an ultimate requirement of 30 acres.

High quality level IV effluent would flow by gravity through a 36 inch diameter, pipeline with an alignment similar to that presented for Alternative 134.

Figure 36 illustrates the Alternative 170 treatment, storage and reuse systems.

Alternative 170 is not suited to staging; therefore, all facilities must be built at the same time. The agricultural demonstration project would have to be completed prior to implementation of this alternative. Surface storage of effluent during the nonirrigation season could be added to Alternatives 134 and 166 if it proved desirable at a later date.

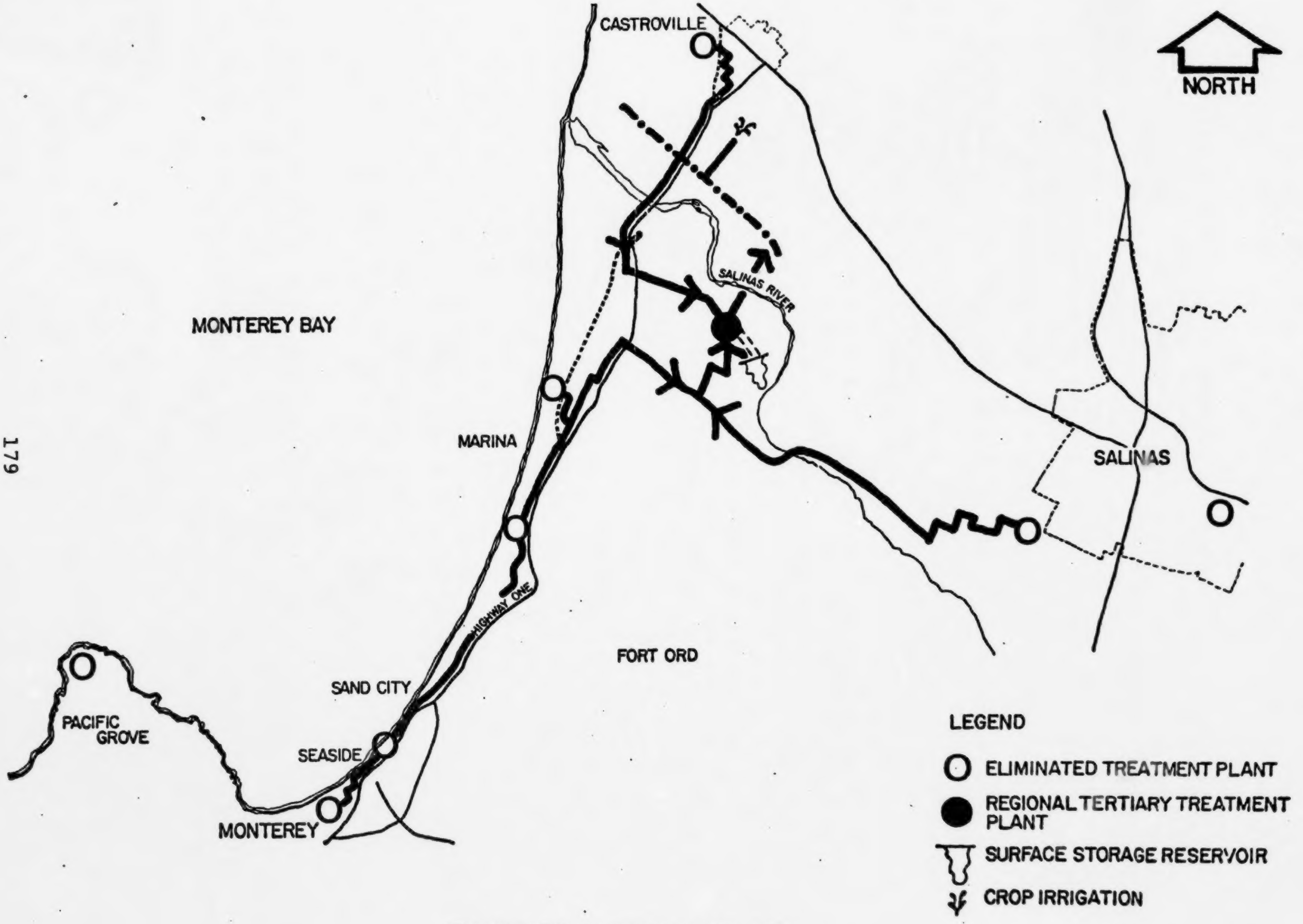


FIGURE 36 ALTERNATIVE 170
CROP IRRIGATION / SURFACE STORAGE

Alternative 171. The basic concept of Alternative 171 is to provide regional secondary wastewater treatment, then to percolate effluent into the ground, a process which will provide additional treatment as well as storage of winter-time flows until required for irrigation. When water was required, it would be withdrawn from the groundwater basin by wells. A key advantage of this alternative is the ability to reuse essentially all of the wastewater without the necessity of providing tertiary treatment or creating large surface storage reservoirs.

In Alternative 171, all existing treatment facilities would be abandoned and raw sewage would be conveyed to a regional treatment facility. Treatment requirements would be secondary with filtration (see Appendix K). Fifteen acres of land would be required initially, with an ultimate requirement of 30 acres.

Infiltration/percolation ponds for the treated effluent would be located in the general area of treatment plant site 4 and would occupy about 185 acres. Construction would be by excavation, with the excavated material being utilized as dikes similar to the surface storage ponds for Alternatives 134 and 170. The principal differences between percolation ponds and large surface storage reservoirs are: 1) storage ponds must be lined with an impermeable material, and 2) percolation areas must be divided into a number of ponds, each having a surface area of about 10-15 acres.

As water is required for irrigation, it would be pumped from the groundwater basin using new wells constructed as a part of this alternative. These wells would generally have a depth of 100 feet and be capable of producing up to 26 million gallons per day total capacity for all wells. Although well locations can only be determined after detailed geologic and groundwater hydrology investigation, they would be located in the vicinity of the storage area shown in Figure 37.

Water pumped from underground storage would be routed to a central location and conveyed to the irrigation area as required, through a 36-inch diameter pipeline. Figure 37 illustrates the possible alignment of this pipeline.

All components of Alternative 171 would have to be on-line prior to abandonment of existing facilities. The only deviation might be in constructing the percolation ponds and drilling the wells. Some of these facilities could be constructed at a later date as demand dictated.

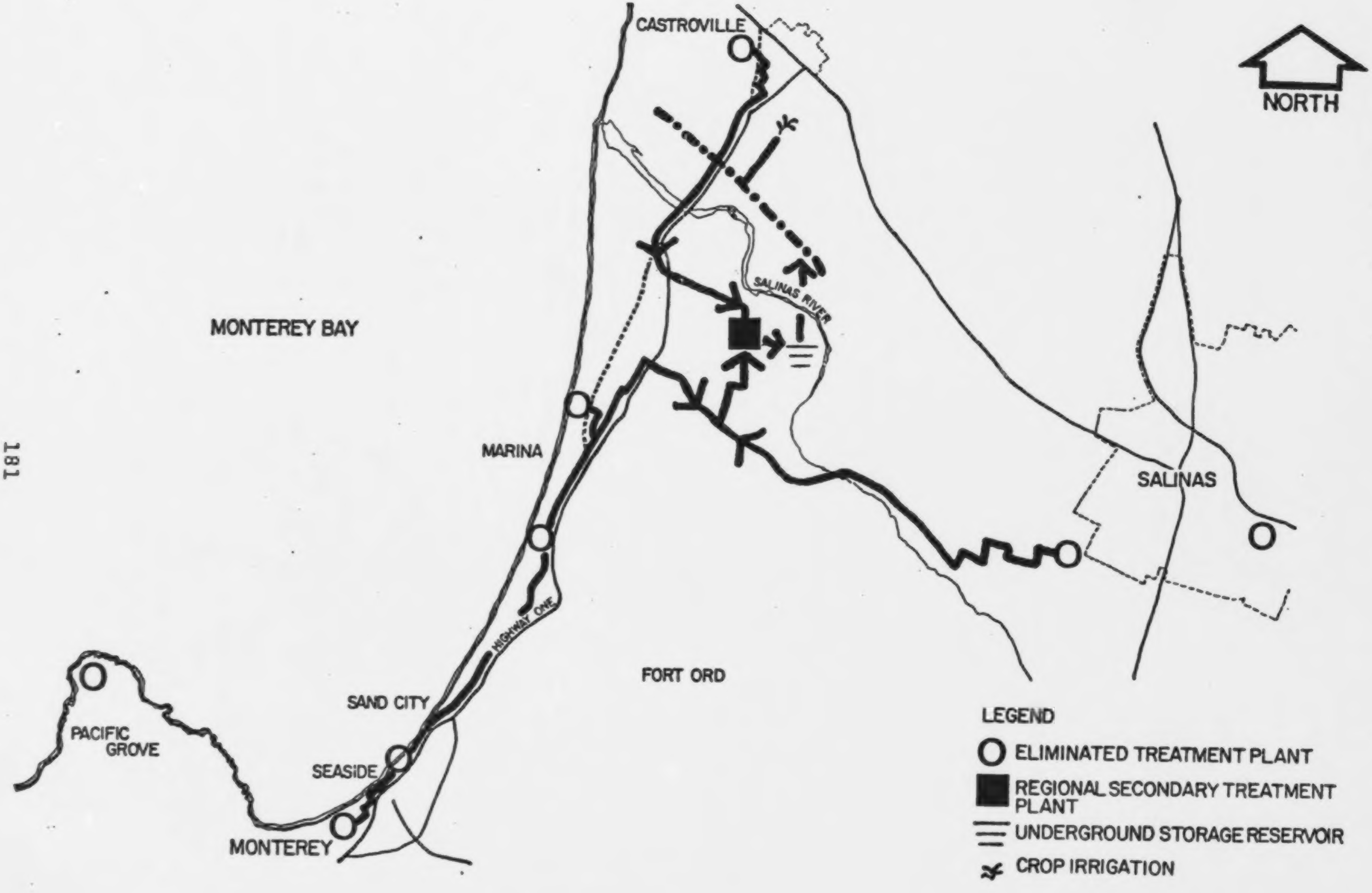


FIGURE 37 ALTERNATIVE 171
CROP IRRIGATION/SUBSURFACE STORAGE

Figure 37 shows the Alternative 171 treatment, storage and reuse system. As with Alternative 170, use of this treatment and reuse method would be dependent on a successful agricultural demonstration project. A relatively expensive geohydrologic investigation of the storage area would also be necessary prior to implementation of the underground storage. The possibility of contaminating potable groundwater supplies below the perched aquifer would have to be determined to avoid health hazards to present and future residents of the area. Underground storage could also be phased into Alternatives 134 and 166 if it proves feasible.

Facilities Sizing

Rationale for Proposed Sizing. All of the facilities sizes described in the preceding sections have been developed by the project engineers after considering a number of variables, including present and projected population within the proposed service area, infiltration/inflow totals, and anticipated waste and flow reduction measures. Development of the service area boundaries was described earlier. The project engineer utilized the 20-year and ultimate build-out population projections developed by local planning agencies. As noted in Table 45 and Figure 42, the local projections are higher than those developed by state and regional agencies. Capacity was included in the system (interceptors, treatment plant, disposal system) for all presently sewered populations plus those residential areas that presently have septic tank problems or those undeveloped areas that are likely to be developed in the next 10-20 years to densities sufficient to require sewering. This project does not provide a collection system for unsewered, inadequately sewered, or currently undeveloped residential areas within the service area, but it does provide major interceptor, treatment and disposal/reuse capacity. If rural communities (i.e., Prunedale, Toro Park, Oak Hills) within the service area are to eventually become a part of the regional system, individual facilities planning and environmental impact studies will have to be done.

One of the three major wastewater interceptors is designed to accommodate flows from the ultimate build-out population (Monterey Peninsula line), while the other two (Castroville and Salinas lines) are sized for the year 2000 anticipated population. The Salinas and Castroville lines are sized for year 2000 only because these two areas are experiencing relatively rapid growth at present. It would be difficult to predict ultimate populations and any miscalculation could result in improperly-sized interceptors. The engineer's infiltration/inflow analysis determined that each of the three interceptors must accommodate some infiltration and inflow into the existing collector system. Their estimates for each route are as follows: Monterey Peninsula line - 14.73 mgd; Salinas Line - 7.34 mgd; and Castroville line - 0.59 mgd (Engineering Science, Inc., 1976d).

The size of the regional wastewater treatment plant is based on the 1990 population projections developed for the service area and the estimated infiltration/inflow. Sizing does not consider growth beyond 1990 because the state-federal Clean Water Grant program will finance facilities for a 10-year planning period only. Capacity beyond that must be locally financed. The design peak wet weather flow capacity of 66 mgd includes wastewater from the 1990 population listed in Table 45 plus a total of 22.66 mgd of infiltration/inflow (Engineering Science, Inc., 1976d).

The effluent transport facilities are designed to convey ultimate peak wet weather flows (PWWF) from the service area. PWWF is a combination of peak dry weather flows from the ultimate service area population, plus the maximum anticipated infiltration/inflow. The regional systems PWWF is expected to be 87 mgd. Therefore, the ocean outfall (Alternative 1 and 166), the Salinas River lagoon outfall (Alternative 134), and the pipeline from the treatment plant to the surface and subsurface storage reservoirs (Alternatives 170 and 171 respectively) are designed to accommodate 87 mgd (Engineering Science, Inc., 1976d).

The pipeline proposed to carry treated wastewater from the regional plant to an irrigation delivery system in the Castroville area (Alternatives 134, 166, 170 and 171) has been designed to accommodate the plant's average dry weather flow of 26 mgd. Sizing of the tertiary treatment facilities beyond this level was considered too expensive by the project engineers. The irrigation delivery pipeline was not sized beyond 26 mgd because nocturnal reservoirs at the irrigation distribution stations should be able to handle daily peak demands (Engineering Science, Inc., pers. comm.).

Waste and flow reduction measures. The project engineers have proposed a variety of waste and flow reduction measures to decrease the daily load of solid and liquid wastes that must be treated by the proposed regional system. The suggested flow reduction measures are as follows:

1. Water metering
2. Incentives through water pricing
3. Public education
4. Modifications in household plumbing, including:
    a. Small tank flush toilets
    b. Low-volume shower heads
    c. Hot water pipe insulation to reduce wasting time
5. Reuse for industrial cooling and for landscape and golf course irrigation
6. Water rationing

(Engineering Science, Inc., 1976d).

Items 1, 2 and 6 above could be implemented by a local water supply agency, while items 3 and 4 could be initiated by either water supply or wastewater management agencies. Item 5 would most appropriately be a wastewater management agency's responsibility.

Modifications to household plumbing are perhaps the easiest implemented, yet most effective means of reducing domestic wastewater flows. Existing facilities can be fitted with relatively inexpensive volume reduction devices (especially toilets and showers), while new developments can be required to use water-saving facilities simply by modifying building codes. County boards of supervisors and city councils have the authority to enact these water conservation and flow reduction measures. Tables 36 and 37 indicate the source of wastewater flows from a typical household and the flow reduction that could be achieved by using low water use household facilities.

The California-American Water Company, which supplies domestic water to the cities on the Monterey Peninsula, has already invoked voluntary water rationing and public education programs in the face of a severe short- and long-term water supply shortage. The water rationing program was discussed earlier in the Water Supply section of the Environmental Setting. To date, the program's success in reducing wastewater flows has not been determined. In addition, the Cities of Monterey and Pacific Grove have revised local ordinances to require use of low-flow water facilities in new dwelling units. The ordinances are aimed primarily at reducing water consumption, not wastewater production.

The possibility of reducing waste solids in the area's waste stream is also being investigated by the project engineers. Several methods of reducing the industrial load will be specifically investigated, including pre-treatment of wastes on-site, and hooking of more industrial discharges to the separate industrial treatment system in the Salinas area. Some of the benefits of reducing waste solids concentrations

Table 36*

HOUSEHOLD WATER USE WHICH RESULTS IN WASTEWATER FLOWS
(family of four)

Use Function	Gallons Per Day	Percent of Total Use
Toilet flush	115	39
Bathing	92	31
Laundry	41	14
Kitchen	33	11
Lavatory	9	3
Utility sink	6	2
Total	296 (74 gpcpd)	100

Table 37*

ESTIMATED PER CAPITA DOMESTIC WASTEWATER GENERATION AND OPTIMUM EFFECTIVENESS OF FLOW REDUCTION MEASURES IN NEW DEVELOPMENT

Water Use	Estimated Present Wastewater Generation (gpcpd)	Percent Reduction Possible[1]	Wastewater Flow Reduction (gpcpd)
Toilet	29	50[2]	15
Tub bath or shower	23	60[3]	14
Dishwashing	6	--	--
Laundry	10	20[3]	2
Garbage disposal	2	--	--
Cooking, cleaning	4	—	--
Total	74	40 (avg)	∿31 (gal)

[1] Estimated reduction presently feasible in new development is estimated to be 30 percent resulting in a 22 gpcpd savings.

[2] Environmental Protection Agency, 1974. Demonstration of Waste Flow Reduction from Households.

[3] Baker, L. K., May 1975, "Household Water Conservation Effects on Water Energy and Wastewater Management."

* Source: U. S. Environmental Protection Agency, pers. comm.

are improved water treatment; reduction in solids handling, treatment and disposal facilities requirements; and an energy savings. The solids load in municipal wastewater may be more difficult to reduce. One of the biggest contributors is the home garbage disposal. A customer education program initiated by the local water supply or wastewater management agency could encourage less use of disposals and a greater reliance on the garbage collection service. Initiation of organic waste composting as an alternative to using the home garbage disposal system should also be encouraged. Composting has the added benefit of supplying an inexpensive, highly effective soil amendment. Elimination of storm drain attachments to the municipal sewer system would also reduce the amount of solids reaching the treatment plant. Periodic checks of storm drains, building down spouts and manhole covers by the wastewater management agency staff can lower the number of illegal or authorized connections to the sewer system.

IMPACT ANALYSIS OF ALTERNATIVE PROJECTS

Introduction

This section of the EIS identifies and discusses the environmental, social and economic impacts of six alternative plans (including no action) for the collection, treatment and disposal (or reuse) of north Monterey County wastewater. The impacts discussed include not only the primary (or direct) effects -- the immediate results of an action -- but also the secondary (or indirect) effects -- the consequences of the direct effects. The time frame of the impact (short or *long term*), its nature, general magnitude and associated indirect effects are described wherever possible. In some cases the analysis refrains from labeling effects as either beneficial or adverse, since these designations often depend on the value system of the person evaluating the impact. Measures which could mitigate (reduce in magnitude) or avoid the adverse aspects of an impact are also identified, where applicable.

The section is organized into several sub-sections to minimize repetition and at the same time facilitate a comparison of the alternatives. The first sub-section deals with short and long-term effects of construction of the project facilities, including interceptors, treatment plant, storage reservoirs and ocean outfall. The short-term impacts are common to most of the alternatives, are relatively insignificant in relation to the total effect of the project, and are usually capable of effective mitigation. They are summarized in Table 38. Those short and long-term construction impacts specific to certain alternatives are discussed separately.

The second sub-section deals with the operational aspects of the alternatives, including wastewater collection, treatment and disposal/reuse. Here, impacts are organized under the various elements of the environment described in the Environmental Setting; i.e., surface water, groundwater, soils, land use, wildlife, etc. In this way, the relative impact of each alternative on a given segment of the environment can be readily compared.

The final two major sub-sections deal with the economic and no action alternative impacts. These are followed by separate chapters on secondary growth impacts, a summary analysis of alternatives, and summary impact discussions required by the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

Impacts from Construction of Project Facilities

Impacts Common to All Project Alternatives

Construction impacts are for the most part short term and capable of being effectively mitigated. Short term in this case refers to the period from initiation of the plan to shortly after the end of construction. Some of the alternatives involve phased construction, but the short term impacts relate mainly to the periods when facilities are being actively constructed, not the intervening periods. The construction impacts common to all of the alternatives (except "no action") and recommended mitigation measures are given in Table 38. This includes impacts from construction of the interceptors and treatment plant.

Impacts requiring additional discussion are presented below.

Wildlife Disturbance. The activities of construction -- human activity, heavy construction movements (subsurface vibration), noise, etc. -- will disturb resident animals causing them to temporarily move out of the construction area. If the adjacent area into which the animals move is already at its carrying capacity for that species, the population of the species would be reduced. For each species displaced, the adjacent population of that species will be affected. The areas of primary concern along the proposed interceptors are the Salinas River riparian habitat and the open grassland on the Armstrong Ranch. The disturbance can be kept to a minimum simply by confining construction activity to the smallest area possible and locating corporation areas and temporary roads away from riparian areas.

Loss of Wildlife Habitat. Loss of habitat results from removal of vegetation and covering of open lands. Clearing and excavation for interceptor and treatment plant construction will destroy some grassland habitat and possibly some riparian vegetation along the Salinas River and Tembladero Slough. The losses, although small, will displace animals as described above. Mitigation measures are described in Table 38.

Table 38

CONSTRUCTION IMPACTS[1]

Impact	Interceptor Routes															Treatment Plant Sites						Recommended Mitigations
	A1	A2	B1	B2	C1-C2	D1	D2	D3	E1	E2	E3	E4	E5	F1	F2	1	2	3	4	5	6	
ADVERSE																						
Traffic disruption	IS*	SS	MS	MS	IS	MS	MS	SS	SS	MS	IS	SS	IS	SS	MS							• Reroute traffic around construction areas. • Provide flagmen in areas where rerouting is not possible.
Creation of noise and dust at construction site	IS	IS	IS	IS	MS	MS	MS	MS	MS	IS	IS	MS	IS	IS	IS	MS	IS	IS	IS	IS	IS	• Keep soil watered down in construction areas. • Require internal combustion engines to have mufflers, baffles. • Perform construction work during normal daylight and working hours.
Increase in emission of aerial pollutants by construction equipment	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	• All internal combustion engine equipment should be equipped with emission control devices.
Visual disruption at construction site	MS	MS	MS	MS	IS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	IS	IS	MS	• Store construction equipment in areas that would not create visual eyesores and minimize impact on vegetation. • Fence or otherwise screen construction maintenance areas. • Avoid extended stockpiling of excavation spoil. • Reseed grassland areas denuded by construction.
Creation of safety hazard at construction site	MS	MS	IS	IS	MS	MS	MS	MS	MS	IS	IS	MS	IS	IS	IS	IS	IS	IS	IS	IS	IS	• Maintain equipment in an enclosed corporation yard. • Keep curious bystanders away from construction areas. • During trenching operations, leave no open trenches for longer than one working day.
Wildlife disturbance[2]	IS	IS	IS	IS	IS	IS	IS	IS	IS	MS	MS	IS	MS	IS	IS	MS	IS	IS	MS	MS	IS	• Avoid removal and/or damage of vegetation wherever possible.
Loss of wildlife habitat[2]	IL	IL	ML	ML	IL	IL	ML	IL	IL	ML	ML	IL	IL	IL	IL	ML	ML	IL	ML	ML	IL	• Confine soil and vegetation removal to the smallest area possible. • Locate spoil disposal sites in areas that would minimize vegetation damage. • Reseed disturbed surfaces and permanent spoil piles with native plants.
Surface water degradation[2]									IS	IS	MS	IS	MS	IS	IS							• Disturb minimum soil area possible. • Stockpile spoil away from areas that drain to major surface waters.
Possible loss of rare and endangered plants[2]	SL	SL		SL	SL																	• If construction activity extends off of road surfaces, conduct detailed field survey of plants in areas to be disturbed.
Loss of agricultural land									IS	IS	MS	IS	MS	MS	IS	ML	IL	SL	ML	ML	SL	• Utilize minimum space possible for permanent facilities. • Avoid construction on prime agricultural land.
Commercial activity disturbance[2]	IS	SS				MS	IS	MS	SS	IS	MS	SS	MS			IL		ML	IL	IL	ML	• Maintain access routes to commercial establishments along construction zones. • Keep noise and dust to a minimum as described above.
Residential area disturbance[3]	MS	MS	MS	MS	MS		MS		MS	IS	IS	MS	IS			MS				IS	IS	• Keep Noise and dust to a minimum as described above. • Maintain access routes to all residences along the construction route.
Loss of archeological resources[2]																						
BENEFICIAL																						
Temporary increase in local and regional economic activity[3]																						• None
Temporary increase in employment[3]																						• None

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[1] See Figure 30 for pipeline routes and treatment plant sites.
[2] Discussed in text.
[3] Common to all construction alternatives.

* Impact Duration and Magnitude - magnitude terminology (i.e., insignificant, moderate, severe) is provided to reflect differences in alternatives and does not necessarily reflect the overall impact on the environment.

IL	Insignificant long term	IS	Insignificant short term
ML	Moderate long term	MS	Moderate short term
SL	Severe long term	SS	Severe short term

Surface Water Degradation. Excavation of farmland, vegetated areas or stream bottom in or adjacent to the Salinas River, Tembladero Slough or Alisal Slough could create temporary turbidity and sedimentation impacts in these water bodies. The likelihood is increased if construction occurs during the rainy season or if revegetation is not properly initiated. Interceptors from Salinas and Castroville have the greatest possibility of creating temporary turbidity problems. The best way to avoid the impact is to hang the interceptors on existing bridges rather than dredge and bury them in stream bottoms. Disturbed areas adjacent to the streams should be replanted with native plants. This could become a significant long-term impact if the revegetation is not accomplished.

Commercial Activity Disturbance. Interceptor-related trenching in roads can temporarily block access to roadside businesses and create noise and dust conditions that may discourage potential customers. Also, construction through croplands can temporarily disrupt normal agricultural operations by blocking access, interrupting irrigation, cultivating or harvesting, and removing land from cultivation. These problems are all short term and can be reduced in severity by maintaining some form of access to adjacent commercial areas and minimizing noise and dust. It would also be helpful to schedule construction through cropland when agricultural activity is at a low point.

Residential Area Disturbance. Construction impacts on residential areas are similar to those on commercial areas. Temporary blockage of access and creation of noise and dust are the major problems. These can be minimized by following standard construction practices such as watering for dust suppression, limiting activity to daylight hours and maintaining alternate accesses to adjacent property.

Archeological Impacts. With one exception, there was no surface evidence of pre-historic sites within alternative treatment plant sites, interceptor alternatives or outfall routes. One probable pre-historic site (JS-MP-1) was located in the vicinity of the Seaside Treatment Plant. It is not within the proposed interceptor route (Alignment A1) that passes the Seaside plant, but it is close enough to deserve mention.

The area of the site covers about 30 meters by 30 meters and is located on the western slopes of a small sand dune. Evidence of prehistoric habitation is sparse but there is sufficient content to consider it as a site.

Cultural material includes chert flakes, retouched flake scrapers, an obsidian flake, thermal fractured rock (broken cooking stone), shell fragments, and mammal bone fragments.

The presence of site JS-MP-1 is probably related to the available water source contained by the fresh water lagoons immediately south of the site location. Other sites may be present, but the unstable sand dunes of the survey area have perhaps concealed any surface evidence of prehistoric occupation.

The lack of sites in areas adjacent to the Salinas River on the secondary terraces cannot be explained. It may be that these areas were subject to periodic overflow of the river and were considered untenable by the Indian population.

Although not on the interceptor alignment, the area of JS-MP-1 should have further testing to allow an evaluation of significance of the site if the pipeline route is moved seaward of the proposed alignment. It is strongly recommended that a minimum of three 1 x 2 meter units would need to be excavated by a professional archeological firm. The analysis of recovered data would permit an evaluation of the site and allow the archeologist to develop specific recommendations concerning further disposition of the site.

Although no sites were identified in other areas of the project, much of the land is covered by active or older, stabilized sand dunes. The dunes may have buried other archeological sites, leaving no surface evidence of their location. It is recommended that construction be halted and a qualified archeologist be consulted for advice should unusual amounts of shell, bone, stone, or artifacts be uncovered during construction activities (see Appendix F for full archeological report).

Energy Consumed in Project Construction. Concern for dwindling energy supplies in the state and nation and the environmental consequences of utilizing the different energy sources has led to a more detailed analysis of project energy consumption in EISs. This includes energy consumed in construction. Quantitative analysis is extremely difficult because detailed facilities design has not yet been initiated. This impact discussion is therefore general in nature.

The energy consumed in constructing the interceptor system would be the same for all project alternatives with the exception of "no action", which would require no new interceptors. The major energy consumers would be pipe delivery vehicles and excavation vehicles. The excavation consumption could best be kept to a minimum by choosing the most direct pipeline routes and the most central regional treatment plant site, and by placing the pipeline on the surface or at the shallowest depth possible. In the past, construction energy consumption has not played a major role in locating facilities; other environmental and economic considerations are likely to be the major factors in selecting pipeline routes and treatment plant site. Fuel consumed by pipe delivery vehicles (or vehicles transporting any construction materials) could be minimized by procuring materials locally whenever possible.

There is also an indeterminable amount of energy consumed in the mining and manufacture of materials used in construction. Aggregate, lumber, steel and clay products all require energy in their production. Use of locally abundant natural materials (clay, aggregate) that require minimal alteration should be encouraged to keep the energy costs of construction to a minimum.

Construction of treatment plants, storage reservoirs and disposal/reuse facilities will require a variety of energy-consuming equipment. Land leveling and grading, transport of construction materials and excavation for pipelines will all utilize gas and diesel-powered vehicles. Energy consumed in construction of the plant itself would be quite similar for the five alternatives. The alternatives with tertiary treatment facilities require slightly more land area and therefore more land leveling. This is insignificant in relation to the total construction energy input, however. Selection of the treatment plant site with the smallest grading requirement is probably the best energy conservation technique available for treatment plant construction.

Storage and disposal facility construction are the major differences between alternatives. Alternatives 170 and 171 would require grading of large areas for storage or percolation/infiltration ponds (900- and 185-acre facilities respectively). Alternative 134 would require construction of a 100-acre storage facility. Alternative 166 would also require a small storage pond. The amount of grading required for each of these depends upon the location chosen and the specific design.

The ocean outfalls of Alternatives 1 and 166 would require use of barges and other sea-going equipment. A large amount of rock and/or sand would be transported to the outfall location or excavated on site to form a berm over the pipe. The irrigation delivery pipelines of Alternatives 170 and 171 would require considerably less energy to construct, as would the river outfall of Alternative 134.

The exact amount of energy consumed in the above-mentioned construction activities cannot be accurately estimated. Table J-11, however, lists the rate of fuel consumption of construction equipment typically used in these activities.

Consumption is best reduced by reducing the amount of construction. Other conservation techniques are also possible, however. Use of the most energy-efficient vehicles and machinery should be encouraged. All motors should be properly tuned and serviced to insure maximum efficiency. Where possible local construction materials should be used. Construction personnel should be locally housed to minimize daily commutes. Worker car pools can be encouraged.

Impacts on Rare and Endangered Wildlife Species. One amphibian and seven avian species considered as rare or endangered are known to or believed to occur within the study area. Two species, the American peregrine falcon and southern bald eagle, occur statewide, with the Monterey area representing a portion of their ranges, while two other species, the California brown pelican and California least tern, occur along the coastline of the study area during the spring, summer and fall.

Known or possible resident rare and endangered species are the California black rail, California clapper rail, and the yellow-billed cuckoo.

Construction and operation of the treatment plant and interceptor systems should not impact any of the bird species mentioned above. The Santa Cruz long-toed salamander is known to inhabit vernal pond areas outside of the study area to the north of Elkhorn Slough. Recent ground and aerial surveys by the California Department of Fish and Game identified nine possible other sites (adjacent to and within the study area); however, no populations have been confirmed (Vestal, pers. comm.). Construction through seasonal or permanent freshwater ponds or surrounding vegetation in dune areas between Monterey and the Salinas River should be conducted only after the California Department of Fish and Game has been consulted in regard to the possible presence of this salamander.

The Smith's blue, which depends on sand dune vegetation for its habitat, could be affected by construction through dunes between Monterey and the Salinas River. Construction along the frontage roads in Seaside, Ft. Ord and Marina should be kept within the existing road bed or immediate shoulder wherever possible, to avoid removal of vegetation important to the Smith's blue's continued existence. Temporary spoil placement and movement of construction vehicles should also avoid dune areas if possible.

Impacts on Rare and Endangered Plant Species. The known locations of plants identified as rare or endangered by the California Native Plant Society were plotted in relation to proposed interceptor systems and treatment plant locations.

Based on this evaluation, it is unlikely that any of the project features will impact known populations of rare or endangered plants. The possibility does exist however, that interceptor or outfall pipelines could impact plants not previously mapped by the California Native Plant Society. The most likely sensitive locations would be in the coastal sand dunes habitat between Monterey and Marina. These areas not only have the potential for containing rare or endangered plants, they include recognized, unique natural areas.

Impacts Specific to Certain Alternatives

Although all of the alternatives include basically similar wastewater collection and treatment systems, there are several different methods of disposal or reuse that are being investigated, and these require construction of slightly different facilities. Alternatives 1 and 166 will require construction of an ocean outfall; Alternatives 134, 166, 170 and 171 will require a delivery pipeline to an irrigation area in the vicinity of Castroville; Alternative 134 will include a small surface storage area and an outfall to the lower Salinas River; and Alternatives 170 and 171 need large land areas for either surface storage (#170) or percolation/infiltration ponds (#171). The impacts of constructing these facilities are described briefly below.

Ocean Outfall. As stated above, Alternatives 1 and 166 require ocean outfalls. The four possible outfall routes being analyzed are shown in Figure 32. For purposes of the analysis, it has been assumed that the treatment plant will occupy Site 4. If another plant site is used, the outfall route will require some adjustment. Impacts likely to result from construction of the land-based portions of the outfalls are presented in Table 39. The seaward route of the outfall has not yet been specifically identified.

Wastewater Delivery Line to an Irrigation Area. All four of the alternatives that include wastewater reclamation will require construction of a pipeline to an irrigation area (Alternatives 134, 166, 170, 171). This line has not been specifically located yet, but is expected to run easterly from the treatment plant, across the Salinas River to the Salinas Valley floor.

The construction impacts of this line are dependent on the location of the treatment plant and the specific route followed, but should be quite similar to those of the interceptors from Salinas to the regional plant (Alignments E1 to E5 in Table 38). One important exception is construction across the Salinas

Table 39

INTERCEPTOR CONSTRUCTION IMPACTS - LAND PORTION OF OCEAN OUTFALL

Alternatives 1 and 166

Impact	Outfall Alternative[1]				Recommended Mitigations
	1	2	3	4	
ADVERSE					
Wildlife disturbance	MS	MS	IS	IS	• Avoid removal and/or damage of vegetation wherever possible. • Plan construction to avoid periods of high transient wildlife populations; nesting and brood-rearing seasonal fall through spring.
Wildlife loss	ML	IL	IL	IL	• Confine construction activity to established rights-of-way whenever possible. • Confine construction equipment and activity to smallest area possible.
Loss of habitat	MS	IS	IS	IS	• Confine soil and vegetation removal to smallest area possible. • Locate spoil disposal sites in areas minimizing vegetation damage. • Reseed disturbed areas and permanent spoil piles. • Confine construction to existing rights-of-way wherever possible.
Water quality degradation (sedimentation)	MS	IS	IS	IS	• Disturb minimum soil area possible. • Avoid cutting banks of surface waterways. • Stockpile spoil away from areas that drain directly to surface waterways. • Regrade and reseed disturbed surface areas.
Stimulus to dune erosion	MS	SS			• Jack and bore pipeline under dunes if possible. • If surface cut made, confine to smallest width possible, and regrade and reseed when construction complete.
Loss of agricultural land	MS	MS		SS	• Confine construction activity to existing rights-of-way wherever possible. • Stockpile and replace excavated topsoil. • Locate equipment corporation maintenance yards on other than agricultural land.
Residential area disturbance	MS	MS			• Keep noise and dust to a minimum as suggested below. • Maintain access routes to residences along construction zone.
Commercial activity disturbance[2]	MS	MS	MS	MS	• Follow mitigations suggested for loss of agricultural land. • Schedule construction to coincide with periods of low agricultural activity. • Maintain access routes to all commercial zones.
Aesthetic disruption	MS	MS	IS	MS	• Store construction equipment in areas that will not create visual eyesores. • Fence or screen construction maintenance areas. • Regrade and reseed areas where vegetation has been removed.

Impact	Outfall Alternative				Recommended Mitigations
	1	2	3	4	
Traffic disruption	MS	IS	IS	IS	• Reroute traffic around construction areas. • Provide flagmen in areas where rerouting is not possible.
Creation of noise and dust at construction site	IS	IS	IS	IS	• Keep soil watered down in construction area. • Require sound baffles or mufflers on all internal combustion engines. • Perform construction during normal daylight and working hours.
Increase in emission of aerial pollutants by construction equipment	IS	IS	IS	IS	• All internal combustion engine equipment should be equipped with emission control devices.
Loss of archeological resources[3]					
BENEFICIAL					
Temporary increase in local and regional economic activity[4]					• None
Temporary increase in employment[4]					• None

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[1] Impact Duration and Magnitude - magnitude terminology (i.e., insignificant, moderate, severe) is provided to reflect differences in alternatives and does not necessarily reflect the overall impact on the environment.

IL	Insignificant long term
ML	Moderate long term
SL	Severe long term
IS	Insignificant short term
MS	Moderate short term
SS	Severe short term

[2] Includes agricultural operation.

[3] Discussed in text.

[4] Common to all construction alternatives.

River. There is no existing right-of-way crossing the river in the probable construction area; therefore, it will be necessary to remove riparian vegetation and trench through the active river bed. This may result in the loss of valuable wildlife habitat and create a short-term sedimentation problem in a small section of the river. The removal of vegetation and presence of construction equipment would also create an adverse short-term visual impact.

These potential impacts could be mitigated by locating the crossing in an area of sparse vegetation. If the construction is performed in the river's low flow season and disturbed stream banks are regraded and revegetated, the sedimentation problem can be kept to a minimum. Revegetation would also mitigate, at least in part, the loss of wildlife habitat.

Salinas River Outfall. The outfall to the Salinas River would be required in Alternative 134. Its alignment has not yet been identified but it would possibly follow the general route proposed for the pipeline to an irrigation area on the Salinas Valley floor (see Figure 34). The construction impacts would be basically the same as those described above for the irrigation delivery line. The short-term sedimentation problem would be less severe, however, as the bank of the river would be cut on only one side.

The short-term sedimentation impact could be kept to a minimum by placing the pipe on the surface where it enters the river, but this could create a long-term adverse aesthetic impact. This does not appear to be a worthwhile environmental trade-off. More appropriate mitigation would be to keep the extent of the bank cutting to a minimum and schedule this activity in the dry season to avoid erosion by runoff.

Surface Storage-Percolation/Infiltration Ponds. Alternatives 134, 166 and 170 require construction of surface storage areas, and Alternative 171 includes construction of infiltration/percolation ponds. These facilities have basically the same types of impacts and will therefore be discussed simultaneously.

None of the pond areas has been specifically located, but it is assumed that the duneland south of the Salinas River and east of State Highway 1 would be used. The heavy construction equipment used to build the necessary embankments and dams would create the same short-term noise, dust, aesthetic and air emissions impacts listed in Table 38. Similar mitigation should be employed. The grassland and its use for livestock grazing would be eliminated in favor of the new use.

For Alternative 166, this loss would be relatively small, around 4 or 5 acres. In Alternative 134, approximately 100 acres of grassland would be lost; in Alternative 170 the loss would be 900 acres and in Alternative 171 it would be approximately 185 acres. The wildlife utilizing or living on this land would be displaced or lost, depending upon their mobility. Future use by terrestrial species would also be eliminated. Several rodent species, jackrabbits, and numerous songbirds and raptors are most likely to be affected.

There is no effective mitigation for this loss of habitat and wildlife other than confining the new facilities to the smallest area possible. Relocation of the facilities would change the location of the impact, but would probably not change its magnitude, as other lands available for use as storage sites have similar vegetative cover. Purchase of property similar to that lost, to be held permanently as habitat, could compensate for the loss to some extent, but would not actually mitigate the loss. Purchase and protection of a large buffer strip around ponds would provide some of this compensation.

Removal of vegetation and disturbance of the soil would increase soil erosion. Wind rather than overland runoff from rainfall would probably be the major erosive force. The sandy soils and rapid percolation rate reduce the effects of overland flow. Heavy equipment should be confined to construction and storage areas to reduce soil and vegetation damage and stockpiled soil material should be wetted during windy periods. Once construction is complete, the disturbed areas should be reseeded with appropriate fast-growing grasses, that are native to the area.

A soil sealer will have to be applied to the interior of the surface storage reservoirs in Alternatives 134 and 170. This material, probably a clay or plastic liner, will be irretrievably committed to the project. The exact amount needed is not known, but it will be substantial for the 900-acre storage reservoir that is part of Alternative 170.

Impacts from Operation of the Project Facilities

The operational impacts discussed below would result from the collection, treatment and disposal or reuse of the study area's domestic wastewater. Both the primary and secondary effects (excluding those related specifically to subsequent population or economic growth) of operation are considered. Impacts on the various segments of the existing environment are discussed separately and each of the five principal project alternatives is given consideration. A summary matrix of operational impacts is included at the end of the section.

Most of the operational impacts are long term in that they will be in effect for the life of the project or longer. These impacts tend to be on or near the facilities site or pipeline route or at the point of discharge. Construction of facilities on one site often tends to encourage use of that location for similar activities for a long time to come. Some impacts are common to all of the alternatives, while others may be specific to a single alternative. Those common to all alternatives will not greatly affect the selection of a recommended plan even though they may be significantly adverse.

Impacts on Water Quality

Groundwater Quality

Reduced Sea Water Intrusion into the Salinas River Groundwater Basin. Alternatives 134 and 166 would deliver reclaimed wastewater to the lower Salinas Valley for crop irrigation during the main irrigation season. In contrast, Alternatives 170 and 171 would deliver the entire annual production of the proposed regional plant's wastewater to the lower valley for irrigation (although delivery would be necessarily restricted to the irrigation season). By substituting wastewater for groundwater being pumped from the 180- and 400-foot aquifers in the Castroville area, the present inland movement of sea water in these aquifers would be retarded. The groundwater trough gradient created by agricultural pumping would gradually decrease as pumping decreased and the encroachment of sea water would lessen.

Alternatives 170 and 171 would have the greatest beneficial effect on the intrusion problem, as they could replace the largest amount of groundwater pumping. Each could deliver approximately 28,500 acre-feet of reclaimed water for irrigation by 1990 (based on projected wastewater flow rate of 25.41 mgd; Engineering Science, Inc., 1976a). Alternatives 134 and 166 would have a lesser, but still beneficial effect. They could supply approximately 16,900 acre-feet of reclaimed water by 1990 assuming a seven-month irrigation season. Alternative 1 would have no beneficial impact on the intrusion problem.

There is no estimate of the present groundwater overdraft available in the pressure area, but in 1955 it was estimated to be 20,000 acre-feet. It is undoubtedly much greater than that now. The reclaimed water supply available through any of the alternatives is therefore probably not sufficient to eliminate the entire overdraft. Some intrusion will continue along the coast, but TDS levels in the 180- and 400-foot aquifers in the vicinity of Castroville should decrease as the cone of depression is reduced. The reduction in TDS would be the most significant change in groundwater quality created by this switch in irrigation water supply.

Addition of Wastewater Constituents to the Groundwater. Alternative 1 would not affect groundwater quality in the study area (excluding possible effects of sludge disposal). The wastewater irrigation alternatives (134, 166, 170 and 171) will influence the water quality of the surface aquifer in the lower Salinas Valley, as part of the irrigated wastewater will percolate through the soil to the underlying aquifer. This thin aquifer is generally less than 50 feet below the surface and is perched above an impervious clay layer (the Salinas aquiclude) throughout most of the lower valley. There may be connections between this and the 180-foot aquifer, but the extent of groundwater interchange between these aquifers is unknown.

The primary elements of concern in the wastewater are nitrogen, salts, biological pathogens, and potentially toxic chemicals. The level IV treatment to be used for wastewaters that would be irrigated on crops would reduce total nitrogen to 30 mg/l or less. An additional decrement would be removed by plant uptake; this could be up to 90 percent of the nitrogen remaining in the soil moisture, depending upon the type of plant irrigated (Pound and Crites, 1973). Plants have varying capacities to take up and utilize nitrogen that is in solution in the soil. The actual amount reaching the groundwater table would be measured in the proposed agricultural demonstration project, but it should not exceed existing conditions, as the nitrogen in the wastewater would simply be replacing nitrogen normally applied to the soils as fertilizer. Artichokes currently receive approximately 200-300 pounds of nitrogen per acre per crop, and lettuce receives 150-250 pounds per acre per crop (Metcalf & Eddy, 1975). Project Alternatives 170 and 171 should convey approximately twice as much nitrate nitrogen to the irrigation area as Alternatives 134 and 166. Although leachate from the irrigation area should not reach a usable groundwater source, the U. S. Environmental Protection Agency drinking water standard for nitrate nitrogen is 10 mg/l as N or 45 mg/l as NO_3 (U. S. Environmental Protection Agency, 1975).

The TDS load of wastewater from the regional plant is expected to be between 725-750 mg/l. In some parts of the proposed irrigation areas, this would be lower than the TDS levels of existing groundwater supplies. In other areas, it would be significantly higher than existing supplies. Therefore, the effect on groundwater would vary considerably. In those areas currently irrigating with water of less than 700 mg/l TDS, the groundwater condition could be adversely affected. In areas where irrigation water has more than 800 mg/l TDS, the groundwater condition may improve. At present, the quality of the surface aquifer is such that few domestic or agricultural wells still draw from this source. Higher quality water is being drawn from the 180- and 400-foot aquifers. The proposed Castroville Irrigation Project would supply the lower Salinas Valley with a higher quality irrigation water. TDS estimates for the CIP range from as low as 240 mg/l (Leonard, pers. comm.) to about 400 mg/l (U. S. Bureau of Reclamation, 1974). Mixing of the treated wastewater with CIP water would reduce the TDS levels of the irrigation water.

Heavy metals and potentially toxic chemical compounds (pesticides, PCBs, etc.) are expected to occur in relatively low levels in the wastewater. Most should be filtered out by the soil column (see soil impacts for more detail). Some stable organic compounds of unknown composition may reach groundwater, however. The long-term effect of many of these compounds on public health has not yet been adequately documented; the agricultural demonstration project should closely monitor the movement of trace elements and stable organics into the groundwater.

The effect of wastewater irrigation on the quality of the deeper 180- and 400-foot aquifers should be negligible or nonexistent due to the relative depth of these aquifers and the presence of the clay aquiclude in the lower valley.

The likelihood of Alternatives 134 and 166 affecting groundwater quality in the surface aquifer is less than Alternatives 170 and 171 because they would supply less wastewater for irrigation use.

Alternative 171 poses an additional threat to groundwater quality in that it includes percolation of wastewater to underground storage in the dunelands north of Marina. Metcalf & Eddy (1975) indicate that an apparently continuous aquiclude exists between the dune sands and the 180-foot aquifer in the vicinity of the proposed infiltration-percolation ponds. However, further detailed geohydrologic study would be needed to ensure that wastewater stored in the dune sands would not infiltrate this aquifer. There may also be wells still drawing water from the upper aquifer to be used as a storage reservoir. Wells drawing from this aquifer could be seriously contaminated by wastewater.

The potential impact on the surface aquifer in the Castroville area could be lessened in several ways. Thorough mixing of the reclaimed wastewater with CIP or well water prior to irrigation would reduce the concentration of pollutants in the soil percolate. A well-managed irrigation program could also reduce the volume of water percolating to the groundwater.

If rates of applying irrigation water are regulated to closely match plant uptake and evapotranspiration, percolation through the soil is minimized. Periods between irrigation applications can also be designed to allow full drying of the soil. This reduces the possibility of overwatering and passage of applied water to the groundwater reservoir. Installation of tile drains to catch subsurface flow would also reduce the effect on the groundwater.

Additional treatment of wastewater prior to delivery for irrigation could also reduce impacts on groundwater supplies. Denitrification and desalinization would reduce the levels of pollutants in the wastewater, but the cost of this additional treatment would undoubtedly far outweigh benefits of such treatment.

The agricultural demonstration project being proposed as part of each of the four wastewater irrigation alternatives should aid in determining the actual effect on groundwater. The program includes monitoring changes in groundwater quality at the irrigation sites. This monitoring should continue if a full-scale irrigation project is implemented.

The possibility of groundwater contamination through subsurface storage (Alternative 171) could be eliminated by opting for surface storage instead (Alternative 170). However, this can create other environmental problems. Before subsurface storage is initiated, a thorough investigation of the underlying geologic conditions should be conducted. If subsurface storage is initiated, a groundwater monitoring program should be required to detect quality changes in adjoining groundwaters.

All of the alternatives could lead to contamination of groundwater at the Marina landfill site if landfilling is utilized as the method of sludge disposal. Estimated sludge volumes are discussed in a following section. The Marina site is a Class II landfill and therefore meets the physical and operational requirements stated in the California Administrative Code for sewage sludge disposal. Sludges with a high percentage of water are usually placed in an area with a leachate control system, however. If leachate controls are not properly maintained, some contamination of groundwater could occur. Heavy metal and biological contamination are of greatest threat to public health. The nearest wells are north and west of the Marina landfill. The chance of affecting wells to the north is extremely remote as pollutants would have to cross the east-to-west gradient of subsurface Salinas River flows. Wells downgradient (to the west) from the landfill would be more likely to be affected. There are at least two within a mile of the landfill's western border.

The possibility of affecting groundwater through landfilling of sludge could be effectively reduced or eliminated in several ways. The most obvious way would be to dispose of sludge in some other manner. Sludge incineration, land spreading and ocean disposal are discussed in the Alternative Projects section. If landfilling is utilized, additional dewatering would lower the groundwater contamination threat. This would require considerable energy and chemical resources, or use of large land areas or open sand drying beds, however. A more effective approach might be to establish a special sludge handling procedure at the landfill with emphasis on limiting percolation of sludge leachate. Discussions between the landfill operator and the appropriate regulatory agencies (RWQCB, State Solid Waste Management Board, County Environmental Health Department) should result in establishment of an appropriate leachate control and monitoring system. The RWQCB has also suggested a geologic study of the site be conducted to verify the continuity of the clay layer that underlies the site. This would indicate the likelihood of sludge leachate reaching the groundwater table.

Surface Water Quality.

Elimination of Domestic Wastewater Discharges to the Lower Salinas River. During low flow conditions (generally May through November), the water quality of the Salinas River below Spreckels is seriously impaired by wastewater discharges from the two Salinas treatment plants. Low dissolved oxygen, high BOD, high nitrates, periodic algae blooms and bacterial contamination are commonplace during the summer (see Tables 6 and E-1 for specific water quality measurements). The source of surface flows (and therefore the water quality problems) during low flow periods just below Salinas is almost exclusively wastewater discharges. Further downstream, agricultural return flows become a significant influence on both flow volume and quality.

All of the proposed alternatives would improve water quality conditions in the river from Spreckels downstream to the Blanco Drain, a stream distance of about 8 miles. Elimination of the Salinas wastewater discharges would decrease surface water nutrient loads, salt content and biological contaminants. It would also reduce flow volume by up to 90 percent in low flow periods. The remaining dry weather flows would be from nonpoint source discharges (i.e., agricultural runoff, groundwater inflow) and upstream reservoir releases that are not percolated to the groundwater table. The quality of these remaining flows might be superior to present conditions, but would still contain TDS, nutrient and bacterial loads in excess of levels recommended for many of the beneficial uses of the river.

Agricultural runoff from the Blanco Drain would continue to impair water quality in the lower river and lagoon. Its runoff typically contains high TDS (3,900-4,300 mg/l), high nitrates (10 mg/l) and moderate pesticide levels. Blanco Drain water is a combination of irrigation return flows and highly mineralized perched groundwater which seeps into the drain. The perched groundwater is a combination of direct rainfall and percolated agricultural runoff. The influx of this water would continue to encourage periodic algae blooms and dissolved oxygen sags in the lagoon.

The specific effect that eliminating the Salinas discharges would have on water quality in the lagoon is difficult to determine. Water quality data for the lagoon have not been collected on a regular basis in the past, and data that are available seldom include flow conditions at the time of sampling. Flows in the river below Spreckels are seldom measured. It seems likely that removing the wastewater would result in increased salinities at the river-lagoon interface during low flow periods, as the influence of ocean tidal influxes and Blanco Drain inflow would increase relative to the present situation. Nitrogen and bacterial loads reaching the lagoon should decrease, but not sufficiently to allow water contact recreation in the area. During normal high flow periods (December through April) the removal of wastewater would have little influence on lower river or lagoon water quality.

Alternative 134, which includes discharge of effluent from the regional treatment plant to the lower river or lagoon, would have a markedly different effect on lagoon water quality. This would be especially true during the low flow period. Initially the treatment plant would be discharging about 20 mgd (flows would vary about a mean of 31 cfs) of wastewater on a year-round basis. Depending upon the level of treatment (level V or level III), this effluent would have a BOD of between 5 and 10 mg/l, total nitrogen of 5 to 30 mg/l and total phosphorous of 0.5 to 6 mg/l. Suspended solids would be between 2 and 5 mg/l (Engineering Science, Inc., 1976b). The lower concentrations represent conditions superior to those existing in the lower river and lagoon, especially during low flow periods. The higher concentrations would probably be similar or slightly higher than existing conditions. The scarcity of data on the lagoon and its water sources, however, make it impossible to accurately estimate the effect the waste discharge would have on the lagoon over a period of time and a range of flow conditions. It is very likely that the level V discharge would have a pronounced beneficial effect on the lagoon by providing high quality flushing flows during normally low flow periods. It is unlikely that it would eliminate current algae problems; however, even level V effluent would have sufficient nutrients to support algae, especially during low flow periods when dilution is low. The level III effluent may have little effect during high flows in the river, but during low flows it would add plant nutrients (nitrogen and phosphorus) that would tend to perpetuate the periodic algae problems in the lagoon. It is likely that algae blooms would continue in the lagoon even in the absence of a wastewater discharge, as large amounts of nutrients are also being contributed by agricultural runoff.

It would be necessary to conduct an intensive water quality and flow monitoring program in the lagoon, the lower Salinas River, Blanco Drain, and the adjacent perched aquifer to accurately estimate the impact of eliminating or increasing waste flows to the lagoon. This is discussed further in the Significant Issues to be Resolved section.

Reduced Wastewater Flows to Tembladero Slough, Old Salinas River and Moss Landing Harbor-Elkhorn Slough. Removal of the Salinas and Castroville wastewater discharges would also beneficially affect water quality in Old Salinas River, Tembladero Slough and the Moss Landing Harbor-Elkhorn Slough area. All of these waters receive biological contaminants and nutrients from the existing discharges.

Old Salinas River and the Moss Landing Harbor-Elkhorn Slough area are affected by both the Salinas and Castroville wastewaters. In the summer, when the sand bar closes the Salinas River mouth, wastewater in the Salinas River can flow from the lagoon into the old river channel and thence into Moss Landing Harbor. This also occurs in the winter, but the quality of the Salinas River flow is much better due to increased dilution from natural surface runoff. The Castroville discharge enters Tembladero Slough, then the old river channel and the harbor. Elimination of the Castroville discharge would be of most benefit to Tembladero Slough, Old Salinas River and Moss Landing Harbor-Elkhorn Slough water quality. Removing the Salinas discharges should also have a beneficial but less significant effect on the old river channel and the Moss Landing Harbor area, especially in the summer months.

Periodic algae blooms and high bacterial counts would probably persist in these waters even after removal of the domestic waste discharges. Agricultural runoff, septic tank leakage and raw waste discharge from boats have been major contributors to the poor water conditions, especially in Moss Landing Harbor and Elkhorn Slough. Until these sources are eliminated, the water quality in Elkhorn Slough will not meet the State Water Resources Control Board criteria for the waterway's assigned beneficial uses. This includes water contact recreation and shellfish harvesting. The Moss Landing Harbor District has taken steps to eliminate waste discharge from boats and the recently-completed Moss Landing Facilities Plan is aimed at removing septic tank leakage problems. Agricultural runoff and other non-point sources of pollution are to be analyzed in the 208 planning effort being conducted by AMBAG.

Alternative 134, with its lower Salinas River wastewater discharge, would add waste flows to the Old Salinas River and Moss Landing Harbor-Elkhorn Slough, primarily in the summer. If level V treatment were being used, there should be no significant impact on water quality. If level III treatment is used, the added nutrient source could contribute to continued algae problems in the old river and Moss Landing Harbor, but only if nitrogen and/or phosphorous are limiting algae growth at present. Numerous point and nonpoint sources are contributing nitrogen and phosphorous compounds to these waters throughout the year, probably in sufficient quantity to support large algae populations even in the absence of domestic wastewater discharges.

Level V treatment would provide the greatest probability that the Alternative 134 wastewater discharge would not adversely affect water quality in the lagoon, but it is not known whether this level of treatment would improve lagoon water quality. It is possible this extra treatment could make the cost of Alternative 134 prohibitive without providing assurance that existing water quality problems will be improved or eliminated. Closing the tide gate between the old river channel and the lagoon in the summer would also eliminate most wastewater-related quality problems in the old river and Moss Landing Harbor, but this may create local flooding of farmlands along the Salinas River Lagoon.

Elimination or Relocation of Domestic Wastewater Discharges to Near-Shore Waters of Southern Monterey Bay. All of the proposed alternatives would eliminate the Monterey, Seaside, Ft. Ord and Marina ocean discharges. These discharges are currently contributing to periodic high nutrient levels in the Monterey Harbor-south bay coastline region. Sluggish circulation in the bay during the spring and summer months aggravates this high nutrient condition which has led to red tides in the past (red tides are large blooms of certain red-pigmented dinoflagellates [phytoplankton], occasionally occurring in such masses that they cause mortality in fish and other nekton as a result of toxins produced by the flagellates). High coliform bacteria counts along the beaches of the south bay indicate the present discharges also create an occasional health hazard.

Alternatives 1 and 166 would create a new wastewater discharge to central Monterey Bay, at least 6,400 feet (1,950 meters) offshore from the mouth of the Salinas River. Initially it would carry about 20 million gallons of freshwater daily to the bay bottom at a depth of at least 72 feet. By 1990 this flow would be 25 mgd. In order to meet SWRCB Ocean Plan specifications, the diffuser at the end of the pipe must be able to provide a 100:1 initial dilution 50 percent of the time and an 80:1 dilution 90 percent of the time. (Initial dilution refers to the ratio of wastewater to sea water in a given volume of the ocean at that point where the effluent plume ceases to rise in the water column.) Engineering Science, Inc. calculations indicate they can meet the 100:1 dilution requirement but not the 80:1 requirement at the proposed location of their outfall terminus. Table 40 provides a rough comparison of the trace metal constituents in the wastewater (prior to dilution) as opposed to those in the ocean. As can be seen, the undiluted discharge would contain significantly higher concentrations of the heavy metals, including iron, lead, copper, zinc, cadmium, chromium and manganese. The estimated wastewater concentrations of chromium, zinc and copper exceed current SWRCB Ocean Plan discharge standards (50 percent frequency standard). This may change, however, as Ocean Plan standards are being revised. The outfall would also establish a new source of nutrients to the bay waters. Total nitrogen is expected to be less than 45 mg/l and total phosphorus is expected to be less than 8 mg/l (Engineering Science, Inc., 1976d).

Considering the depth and distance offshore, this discharge should have little effect on the bay's nearshore water quality. More information on current patterns is being collected by Engineering Science, Inc. at the outfall site so that this impact can be better documented. New data will be incorporated into the EIS as it becomes available.

Alternatives 170 and 171 would benefit bay water quality most, as they completely eliminate wastewater discharges to southern Monterey Bay. Alternative 166 would discharge to the central bay only part of the year; primarily from November to March or April. Alternative 134 would indirectly discharge to the bay through the Salinas River lagoon from November to March or April. This lower river discharge could create increased nutrient, bacterial and trace element concentrations in nearshore bay waters south of the mouth of the river. The quality of the river discharge would be somewhat better than the proposed deepwater ocean discharges, however. Nitrate, phosphate and suspended solids concentrations and bacterial counts would be significantly lower. (See Table K-1; level 1A treatment is proposed for the ocean outfall; either level III or level V may be used for the lower river discharge.)

Table 40

CHEMICAL COMPARISON OF TRACE METALS IN SEA WATER AND PLANNED BAY WASTEWATER DISCHARGE

Average Sea Water Concentration[1] Element	mg/l	Wastewater Concentration[2] mg/l
B	4.5	0.57
N (NO_3)	15	12.9
Na	10,000	146
Mg	1,300	23.6
K	390	12.8
Ca	410	45.0
Cr	0.0005	<0.03*
Mn	0.002	0.21
Fe	0.003	0.80
Ni	0.007	<0.06
Cu	0.003	0.21*
Zn	0.01	0.35*
Cd	0.0001	<0.001
Pb	0.00003	0.06

[1] Goldberg et.al., 1971.

[2] Metcalf & Eddy, 1975.

* Exceeds current SWRCB Ocean Plan discharge standards.

Any adverse ocean water quality conditions produced by the Alternative 134 lower river discharge could be mitigated by using the higher level of wastewater treatment (level V). If the lower level of treatment is to be used, a water quality monitoring program should be initiated in the nearshore bay waters, primarily south of the river mouth.

Change in Character of Agricultural Return Flows. The four wastewater reclamation alternatives (134, 166, 170 and 171) would change the quality of water used for crop irrigation in the Castroville area. Instead of well water, treated wastewater or a combination of well water and treated wastewater would be used. If the Castroville Irrigation Project is built, the wastewater would be mixed with surface flows from the Salinas River prior to irrigation. The wastewater component would be greater (on an annual basis) for Alternatives 170 and 171 than it would for Alternatives 134 and 166.

The major changes in the irrigation water quality would include TDS, heavy metal concentration, and nutrient load. A direct comparison of ground and wastewater quality is difficult to make because the quality of the groundwater used in the Castroville area is extremely variable, but a brief summary of the two sources is presented below.

	Wastewater Supplied for Irrigation (mg/l)[1]	Groundwater in the Castroville Area (mg/l)[2]
TDS	725-750	270-2,750
Total N	30	<1 to 88 (NO_3 only)
Cd	<0.002	<0.002[3]
B	0.5-0.6	0.00-0.70
Cl	185-214	22-1,200

[1] Engineering Science, Inc., 1976d.
[2] California Department of Water Resources, 1973, 1974.
[3] Monterey County Flood Control and Water Conservation District, 1971.

The water flowing from irrigation areas to surface streams is primarily subsurface runoff that has been intercepted by either tile drains or drainage ditches. Very little irrigation water flows from the fields without percolating through the soil first. Use of the wastewater should increase the TDS content of irrigation return flows in some areas, but may reduce TDS in areas now irrigating with higher TDS groundwater. Nitrate and heavy metal concentrations in runoff may also increase slightly, but a large percentage of these components may be filtered out by the soil prior to reaching drainage ditches. Agricultural runoff currently carries a high nitrate and phosphate load from fertilizer applications. If the nitrogen component of the wastewater is used as a fertilizer source, manufactured fertilizer applications could be reduced and total nitrogen in runoff may actually decrease.

Irrigation runoff enters a number of surface waters in the Castroville area. Alisal, Tembladero and Moro Cojo Sloughs, Blanco Drain, Old Salinas River and the lower Salinas River all receive direct and indirect runoff. A change in return flow nutrient content would have the most pronounced effect on the quality of these waters. All experience algae problems at some time during the year. Elimination of direct wastewater discharges (Salinas and Castroville) should have a greater influence on the future quality of these surface waters than a slight increase or decrease in nitrogen and phosphorous in agricultural runoff. Once the point-source pollution is eliminated, however, the agricultural runoff will have a greater influence.

Changes in quality of runoff could be mitigated by avoiding use of wastewater for irrigation. This, however, does nothing to aid the water supply shortage in the area. Increased wastewater treatment could remove additional increments of nutrients, salts and heavy metals, but this would be at considerable expense. The agricultural demonstration project proposed for all reclamation alternatives should study the differences in quality of return flows created by use of effluent. If a problem is identified, it may be necessary to intercept irrigation runoff for reapplication or some form of treatment rather than allowing it to reach the area's surface waters. Thorough mixing of wastewater with Salinas River surface diversion or good quality groundwater could also reduce the potential adverse effects on surface water quality.

Possible Surface Water Contamination from Sludge Disposal at the Marina Landfill Site. Sludge produced by all of the five alternatives would be either partially or totally disposed of in the Marina landfill. If the primary-secondary sludge is dewatered, it would have a solids content of between 20 and 30 percent, and the initial volume would be about 114 tons per day.

The exact method of sludge disposal has not yet been determined; it may be deposited and covered in an isolated section of the landfill site or it may be spread over a large area for drying and then be plowed into the soil for subsequent use as covering material. If it is not dried beyond the 20 to

30 percent solids level prior to landfilling, it may eventually affect surface waters in the Salinas River immediately adjacent to the Marina landfill. A leachate recovery ditch presently intercepts surface and subsurface runoff from land upslope from the active landfill. Sludge placed upslope from the ditch could eventually contribute water to the leachate. It could also increase the heavy metal, organic and bacteriological components of the leachate. Presently this leachate is discharged to the lower Salinas River about 2 miles upstream from the Highway 1 bridge. The quality of the flow is to be monitored in the future as a condition of the Regional Water Quality Control Board discharge permit required for the site.

Any increase in the heavy metal or bacterial content of the landfill discharge would adversely affect the river's water quality, especially as it relates to recreational and wildlife uses. The river already has high coliform bacteria counts from direct discharge of wastewater upstream.

These problems could be avoided in a variety of ways. The most obvious would be use of a different sludge disposal method. The impacts of incineration and landspreading are discussed in the Alternative Projects section. They could also be reduced by additional sludge dewatering prior to landfilling. This could be accomplished at the treatment plant by forced-air drying or sand-bed dewatering, but these methods have other environmental and economic shortcomings. Forced air drying requires a large amount of energy and sand drying necessitates purchase or lease of large land areas. Using the sludge as a soil amendment or land spreading and tilling it into the soil on the landfill site prior to disposal may be the most effective means of avoiding water quality problems. These alternative sludge dewatering processes are also discussed in the Alternative Projects section. If thorough dewatering of the sludge proves undesirable for any reason, the leachate trapped in the landfill recovery ditch could be pumped to the treatment plant for treatment, thus avoiding discharge to the Salinas River. MPWPCA, the State Solid Waste Management Board, the Monterey County Environmental Health Department, the Regional Water Quality Control Board, and the landfill operator should jointly investigate a landfilling method that would effectively avoid surface or subsurface runoff and still be acceptable to all concerned.

Impact on Water Quantity

Increase in Local Groundwater Supplies. Alternative 1 would have no impact on local water supplies. The other alternatives could beneficially affect the current water supply shortage in north Monterey County by substituting reclaimed wastewater for groundwater being pumped for irrigation in the lower Salinas Valley. The benefit would be realized by freeing groundwater currently used in crop irrigation for some other use. There would not be a straight one-for-one benefit accrued by the groundwater basin, as some losses in reclaimed water would occur during delivery (i.e., evaporation, loss to the surface aquifer). The groundwater basins and surface water supplies for the lower Salinas Valley and the Monterey Peninsula are currently overtaxed; this has resulted in development constraints in some areas and sea water intrusion into coastal groundwater aquifers. Realization of the benefit is dependent upon a successful demonstration of the feasibility of irrigating fresh produce crops with wastewater in the Castroville area.

Alternatives 170 and 171 could supply 14,500 acre-feet of irrigation water to the lower Salinas Valley by 1982 and 28,500 acre-feet by 1990 (this excludes evaporative and percolation losses during storage). This would in effect increase local groundwater stores by a similar amount. Alternatives 134 and 166 could supply approximately 8,400 acre-feet of wastewater for irrigation in 1982 and 16,900 by 1990 (assuming 7-month irrigation season), thereby benefiting the local water supply situation to a lesser degree. The actual amount of wastewater eventually supplied for irrigation might be somewhat less than these figures, as the demand for water will fluctuate from year to year. The proposed Castroville Irrigation Project has an anticipated total water demand of 18,000 acre-feet (April through October irrigation season). This added water supply is considerably less than the overdraft on the Salinas Valley pressure aquifers. Estimates of the current overdraft are not available, but in 1955 it was estimated to be 20,000 acre-feet, with a safe yield in the area of 78,000 acre-feet (Yoder-Trotter-Orlob & Associates, 1973). Groundwater pumping has increased since 1955.

Use of reclaimed wastewater in the Castroville Irrigation District could reduce or eliminate the need for Castroville Irrigation Project water, depending on which wastewater project alternative is selected. The Salinas River surface flow that would have been allowed to pass downstream to a diversion point near Salinas as part of the CID project could be used instead to further augment the Salinas River groundwater basin through percolation above Salinas. It could also be allowed to flow past Spreckels and augment surface flows in the lower river, thereby benefiting vegetation and wildlife.

If the proposed irrigation demonstration project determines that wastewater irrigation of fresh produce crops near Castroville is not feasible, the five project alternatives may have little influence on local water supply. The location of the regional treatment plant does not facilitate other reuse options (i.e., golf course, landscape, and park irrigation) that would free existing water supplies. Existing plants could be retained to implement some reuse options on a local basis, however. Cities on the Monterey Peninsula are currently investigating local options, but no published information on their investigation is available to date. Deep well injection of the wastewater to form a salt water intrusion barrier might benefit water supplies in the Moss Landing-Castroville area, however. The aquifers being intruded by sea water are used for both domestic and agricultural supply and unless pumping is decreased in the area or freshwater influx to the aquifers is increased, these existing supplies will continue to deteriorate. Aquifer injection was considered in early project planning but was rejected due to its high cost and the potential public health problems associated with wastewater contamination of domestic water supplies.

If local treatment plants are maintained after construction of the regional plant, some wastewater could be locally treated and used to irrigate golf courses, landscaped areas or parks. This possibility is currently being investigated by the Monterey Peninsula cities. This would benefit the local water shortage, but to a lesser degree than a large-scale irrigation project.

Reduced Surface and Groundwater Levels Along the Lower Salinas River. All of the proposed regional wastewater alternatives would eliminate the two Salinas wastewater discharges to the lower Salinas River. In the summer months when these discharges represent most of the surface flow in the river, their removal could eliminate surface flows and would lower the groundwater levels in the surface aquifer along the river.

The current condition of the surface aquifer along the lower river is not well documented. Most of the wells in the area that are monitored by the California Department of Water Resources or the Monterey County Flood Control and Water Conservation District are drawing water from the deeper 180- and 400-foot aquifers (Thorup, pers. comm.; Monterey County Flood

Control and Water Conservation District, n.d.). The latest soil survey of the area indicates that depth to groundwater in soils bordering the river above the lagoon is generally greater than 6 feet (U. S. Department of Agriculture, Soil Conservation Service, 1975). Removal of the Salinas discharges should practically eliminate summer season surface flows between the City of Salinas and Blanco Drain. The groundwater table presently being fed by these flows would lower. The extent of the drop cannot be determined without detailed data on the existing surface aquifer condition.

The impact of this reduced surface and groundwater supply would be felt most by the wildlife and vegetation that currently rely on it. There is little, if any, domestic or agricultural use of surface flows or surface aquifer groundwater downstream from Salinas in the summer. The impact on wildlife and vegetation is discussed in a later section, and mitigations are suggested.

Impacts on Agriculture

When discussing the impacts of irrigation with reclaimed effluent, the question invariably arises, "impacts compared to what?" For example, MPWPCA reclaimed water is substantially better for irrigation than water from some wells in the Castroville area which have been intruded by a large percentage of sea water. On the other hand, it is poorer in mineral quality than Salinas River water flowing above Salinas. This surface water is being sought as part of the Castroville Irrigation Project for use in the Castroville area (the likelihood of this project being implemented is presently questionable, see page 248).

Soils. Alternative 1, of course, has no known impact on agricultural soils. There is no known difference between the impact of Alternative 134 and Alternative 166. They will therefore be considered as one alternative for purposes of this analysis. Alternative 170 is different from Alternative 171 only in that denitrification may occur in the storage reservoir. Although summer evaporation may increase the total dissolved solids (TDS) in the reservoir, winter rains will almost make up the difference, and it is not believed that this report can successfully delineate any differences in this regard.

Salt Buildup Within the Soil. For the purpose of this analysis, salinity is interpreted to be synonymous with TDS. Aside from specific ion effects, which will be discussed later, the danger of damage to crops from high salinity relates to the increased osmotic component of the soil suction, making it more difficult for plants to extract moisture. Ayers and Branson (1974) classify water having specific conductance between 750 and 3,000 µmhos/cm as causing "increasing problems". ("Increasing problems" is used in the context that the problems increase as the water quality degrades from EC 750 to 3,000 µmhos/cm [roughly 470-1,900 mg/l TDS].) A typical EC of the reclaimed water to be delivered for irrigation is 1,223 µmhos/cm, placing it well into the category of "increasing problems". Existing groundwater supplies being used for irrigation in the Castroville area have EC values ranging from 238 to 4,550 µmhos/cm due to sea water intrusion; much of the existing irrigation supply is therefore also of poor quality and will get worse if pumping continues at present levels.

The effect of salinity can be mitigated by leaching to prevent harmful buildup of salts within the root zone. This leaching process, of course, increases the cost for both labor and water, and will be discussed more fully under a later section, as will harmful side effects of leaching.

In vegetable growing, it is a common practice to plant some crops such as lettuce on beds and to irrigate furrows between the beds. The water rises to the top of the beds (subs) by capillary action, and germinates the seeds. This process aggravates the accumulation of salt on the beds. If the water is salty, the humidity low, and high evaporative conditions exist, sufficient salt accumulates on the bed to inhibit the germination of the seeds or burn the seedlings after emergence. This damage is commonly mitigated by sprinkling. The disadvantages of sprinkling will be discussed under the section entitled Agricultural Practices.

Sodium Status of the Soil. Sodium (Na) is important in the soil for two reasons: First, if its ratio to other cations is too high, it can cause deflocculation of the clay colloids, leading to permeability problems. Second, the ion Na can be toxic to plants if its concentration is too high.

The permeability hazard can be evaluated mathematically by the Sodium Adsorption Ratio (SAR),

$$\frac{\mathrm{Na}^{+}}{\left(\frac{\mathrm{CA}^{++} + \mathrm{Mg}^{++}}{2}\right)^{1/2}}$$

where the ions are expressed in equivalents per million.

A modification of the SAR has been developed by the U. S. Salinity Laboratory to adjust it for the added effects of the precipitation of calcium (Ca) and magnesium (Mg) due to the presence of carbonate, bicarbonate or hydroxide in the water. This modified formula is expressed as:

$$\text{SARadj.} = \frac{Na^{+}\,(1 + 8.4 - pH_c)}{\left(\frac{Ca^{++} + Mg^{++}}{2}\right)^{1/2}}$$

where the ions are expressed in equivalents per million, and where $pH_c = (pK_2' - pK_c') + p(Ca + Mg) + Alk$

The SAR and the SARadj values for the effluents under consideration are shown below.

STANDARD AND ADJUSTED SAR VALUES

Treatment Plant	Standard SAR	Adjusted SAR
Salinas #1	6.2	11.3
Monterey	4.5	6.8
Fort Ord	2.1	4.1
Pacific Grove	2.7	5.2
Seaside	5.8	12.6
Marina	a	a
Salinas #2	1.9	3.7
Castroville	3.4	7.8
Flow weighted average	4.3	7.8

[a] Insufficient data

Ayers and Branson (1974) indicate that as water increases from SARadj 6 to 9, there are increasing problems of soil permeability. This concept assumes a leaching fraction of about .3; with a leaching fraction of .07 as assumed in the salinity sections, the SARadj would be approximately doubled (Ayers, pers. comm.). The .07 leaching fraction is recommended as appropriate for use by the University of California (Ayers and Branson, 1974). Based on the above calculations and guidelines, some permeability problems could arise from the use of effluent from the proposed regional plant. The actual significance of this impact can only be determined by the proposed agricultural demonstration project.

Permeability problems related to high SARadj in the irrgation water can be mitigated by the addition of gypsum to the irrigation water. Usual application rate is from 200 to about 1,000 pounds gypsum per acre-foot of water (Ayers and Branson, 1974). Source control of salts entering the waste stream can help reduce SARadj values. Industrial inputs at Salinas should be analyzed to see if they are contributing excessive amounts of salts. If they are, pretreatment might be encouraged or additional industries could be hooked into the Salinas industrial treatment system. Efforts could also be made to reduce salt contributions from water softeners both by educating the general public as to the adverse effects caused by their individual discharges and by controlling inputs from the major water softener reconditioning companies in the area.

Cadmium or Other Potentially Toxic Materials Buildup in the Soil. Some of the soils in the Castroville area contain substantial concentrations of naturally-occurring cadmium (Cd) (Univ. of Calif., Davis, Dept. of Soils and Plant Nutrition, 1973). Therefore, any additional increment of this element is of special concern, both because of its phytotoxic effects and the hazard to the human food chain. Fortunately, the concentrations shown in the available analyses of study area wastewater are very low, and buildup would be slow. For example: Some soils in the Castroville Irrigation District contain as much as 1.5 mg/kg Cd. Twenty years of irrigation with 3 acre-feet of water per year having .004 mg/l Cd (the highest concentrations found in existing waste streams; therefore, a "worst case" estimate) would add about .3 mg/kg to the top 6 inches of the soil, making the maximum concentration of CID about 1.8 mg/kg Cd in the top 6 inches.

The allowable concentrations of Cd in the soil have not been determined as of this writing, nor has the long-term fate of Cd in the soil been agreed upon by scientists studying the phenomenon. The foregoing calculations assume the worst possible situation insofar as soil reactions are concerned. The effect could be mitigated to some extent by heroic plowing to mix the Cd to deeper depths. Obviously, if the .3 mg/kg were evenly mixed to a depth of one foot, the soil concentration would be increased by only .15 mg/kg.

The National Academy of Science (NAS) (1972) has published recommended maximum concentrations of trace elements in irrigation water. The flow-weighted average quality of the combined study area effluents (as estimated by Metcalf & Eddy, 1975) includes copper and manganese levels in excess of the NAS criteria for continuous use on all soils.

Copper and manganese are immobile in the soil and will accumulate in the shallow horizons. The only mitigation known as of this writing is deep tillage. Allowable concentrations have not been determined as of this writing.

Crops

Reduction in Crop Yields Due to Salt Buildup. As stated earlier, crop yield reduction due to salt buildup (aside from specific ion toxicity) is related to the increase in the osmotic component of soil suction. Some species are more tolerant of salinity than others. Ayers and Branson (1974) have classified crops according to their salinity tolerances as well as yield decrement to be expected with certain management practices. Among the more tolerant crops which are being grown in the CID area are tomatoes and the cole crops (cabbage, cauliflower, etc.). Lettuce is more sensitive to salt buildup, as are beans; and strawberries are among the most sensitive of all the crops. Little information is available on artichokes, but Metcalf and Eddy (1975) classify them as highly tolerant to salinity, based on Tunisian data (see Table 41).

Table 41

CHEMICAL SENSITIVITIES
AND FERTILIZATION APPLICATIONS FOR
SELECTED CROPS GROWN IN MONTEREY COUNTY

Crop	Salinity tolerance[a]	Relative boron tolerance[b]	Nitrogen application, lb/acre/crop
Lettuce	Low	Tolerant	150-250
Artichokes	High	Tolerant	200-300
Broccoli	Moderate	Semitolerant to tolerant	150-300
Cauliflower	Moderate	Semitolerant to tolerant	175-265
Tomatoes (fresh produce)	Moderate	Semitolerant	150-200
Celery	Low	Semitolerant	500
Strawberries	Low	Sensitive	100-150

a. High: conductivity <10,000 μmhos/cm; moderate: conductivity <4,000 μmhos/cm; low: conductivity <2,000 μmhos/cm [25].

b. Tolerant: boron <4 mg/l; semitolerant: boron <2 mg/l; sensitive: boron <1 mg/l [25].

Source: Metcalf & Eddy, 1975.

The effects on crops of increased salinity in irrigation water can be mitigated by appropriate leaching. Table 42 illustrates the minimum leaching required to maintain full production with the reclaimed water compared with the water that may become available through CID. Well waters in the CID are so variable that averages are not very meaningful, ranging from EC 238 to 4,550 µmhos/cm (Monterey County Flood Control and Water Conservation District, n.d., TDS levels range from 420 to 3,500 mg/l). If leaching is utilized to counterbalance increases in irrigation water salinity, the impact this might have on groundwater must be considered. In areas where the surface aquifer is already of poor quality and is not being used for domestic or agricultural purposes, the added leaching of salts would create no new problems. However, if good quality groundwater could be affected, it may be necessary to install tile underdrains to avoid undesirable salt buildup in the groundwater.

Table 42

COMPARISON OF LEACHING REQUIREMENTS*
FOR CROPS WITH TWO ALTERNATIVE WATER SOURCES

Crop	Average Reclaimed Water (EC 1,200 µmhos/cm)	CIP Water at Spreckels Diversion	
		(EC 388 µmhos/cm)**	(EC 638 µmhos/cm)***
Tomatoes	10%+	3.0%	5.0%
Broccoli	8%	2.5%	4.0%
Cabbage	8%	2.5%	4.0%
Lettuce	12%	3.0%	6.0%
Strawberries	20%	7.0%	10.0%

* Based on *Guidelines for Interpretation of Water Quality for Agriculture*, U. C. Committee of Consultants, December 1, 1974; and assuming 60% irrigation efficiency.

** EC estimate based on conversations with Central Coast RWQCB staff and review of water quality data collected at Gonzales; this is best-case estimate.

*** EC estimate from average quality of diverted water reported in the Castroville Irrigation Project Report (U. S. Bureau of Reclamation, 1974).

+ Percent of applied water that must pass the root zone to avoid exceeding salt tolerance, assuming 60% irrigation efficiency.

Reduction in Crop Yield Due to Specific Ion Toxicity. Boron (B): Although NAS (National Academy of Science, 1972) limits water to .75 mg/l B for waters used continuously on all soil, higher concentrations are tolerable where tolerant crops are grown. As stated earlier, annual crops such as lettuce, celery and cabbage are tolerant to B. No data are available for artichokes. If the irrigation water is a composite of all the cities, the B concentrations will slightly exceed the limit set by Ayers and Branson (1974) for sensitive crops, but will be below the NAS limit.

Good mitigation measures are not available for B toxicity. This element can be leached from the root zone only with difficulty, and with considerable expense.

Chlorides (Cl): Strawberries are the most sensitive to chlorides of the crops being grown in or near the CID, but if sprinklers are used in low-humidity, high-evaporative conditions, chlorides may cause a problem on a wide range of crops. Ayers and Branson (1974) indicate increasing problems as the chlorides increase above 106 mg/l. They further indicate increasing problems from root absorption as the chlorides increase from 142 to 355 mg/l. Based on the available analyses, the weighted average effluent would create problems of leaf burn if sprinklers are used under low humidity, high evaporative conditions. These conditions infrequently exist in the Castroville area, so the real threat of damage is low. Some problems with root absorption should be expected, however.

Chloride damage to foliage by sprinklers can be mitigated to some extent by nighttime sprinkling. The effects of nighttime sprinkling on cultural practices will be discussed later. Damage through root absorption can only be mitigated by increased leaching and the growing of tolerant crops. As pointed out in the introduction to this section, however, the effluents may cause considerably less damage to crops than some water from wells that have been intruded by sea water.

Sodium (Na): Like chlorides, NA can damage plants either by burning the leaves if they are sprinkled on hot dry days, or by being absorbed through the roots. Ayers and Branson (1974) indicate increasing problems with foliar burning as the Na concentrations exceed 69 mg/l in the irrigation water, and increasing problems due to root absorption as the SARadj increases from 3 to 9. They indicate severe problems if the SARadj exceeds 9. Based on the available analyses, the weighted average effluent could cause some problems of leaf burning, especially if sprinkled under low humidity, high evaporative conditions. It would also create some problems due to root absorption. The actual threat of sodium damage in the Castroville area is greater than the threat from chloride due to the relatively high levels of NA in the flow-weighted effluent.

Sodium damage to foliage as a result of sprinkling can be mitigated to some extent by nighttime sprinkling. Damage due to root absorption can be mitigated by growing tolerant crops, and by increasing the leaching. As with chlorides, however, the effluent water may be considerably less damaging than water from sea water-intruded wells.

Nitrates (NO_3): Baier and Fryer (1973) point out that excessive nitrogen (N) fertilization can reduce crop yield or crop quality, even though it may not necessarily be toxic. For example, tomatoes that are over-fertilized may "go vegetative", produce beautiful vines but inferior fruit. The crops most likely to have this problem in the CID area are strawberries, tomatoes and sugar beets, none of which occupy large acreages. The damage can be mitigated by using low N water for irrigation at the critical stage of growth. In this respect, Alternative 170 would be more advantageous than Alternatives 166 or 171 because the water in storage in the reservoir will likely become denitrified and could be used for N sensitive crops. Depending upon the size and retention time of the equalizing reservoir in Alternative 134, some manipulation may be possible to reduce the N concentrations for these special groups. It is recognized that such manipulation may cause logistic problems for the water supplier. If the high N water is used on sugar beets or tomatoes throughout the growing season, the possibility of crop damage is high.

Effect of Effluent Irrigation on Agricultural Practice. A reliable surface water supply of reasonable quality is a great asset to any irrigation farmer. He is freed of cares about pumps that fail in mid-irrigation season, rising power costs, standby charges, and in the case of CID, sea water intrusion. He can, if he wishes, ordinarily call for a bigger head of water than is available from his own well. He can devote his energies to farming rather than to being a water supplier. For those farmers whose wells have been intruded by sea water, the effluent may represent a substantial improvement in water quality.

Reclaimed effluent delivered under Alternative 166 is estimated to contain 30 mg/l of N and 1.5 mg/l of phosphate (P). At the prevailing price of $0.15 to $0.25 per pound for N, the value of that constituent (when needed) ranges between $12.21

and $20.35 per acre-foot. The cost of fertilizer has been steadily increasing, so the value of the N and P in applied wastewater would also increase with time. Under Alternative 170, and to a lesser extent 134, the N concentration may be somewhat lower, depending upon retention times in the reservoirs. The value of the P in the water is relatively less than it is for N because to have maximum value, in addition to being needed, P must be strategically placed in the soil near the germinating seed. Nevertheless, phosphate in the water has some small finite value in building up the general fertility level of the soil. Nutrients in wastewater have a small additional value in that they are applied simultaneously with irrigation water, reducing somewhat the separate fertilizer application costs.

Mitigation measures indicated in earlier sections of this report frequently included increased leaching. Table 42 shows quantitatively how much additional leaching would be required as compared to stored water. Additional leaching involves extra expense for equipment, labor, and power. It also implies additional drainage requirements. For some farmers, this means installation of artificial drainage structures such as tile drains, interceptor ditches, etc. Furthermore, whenever leaching occurs, the nitrates are flushed from the root zone along with the chlorides and other salts. This represents an economic loss to the farmer and may aggravate the waste disposal problem. Finally, it raises the question of disposal of irrigation return waters. At this time the California State Water Resources Control Board (SWRCB) has not developed a clear policy relating to these permits (Peck, pers. comm.), particularly when the water source is reclaimed effluent.

California Department of Health (1974) guidelines state that irrigation wastewaters shall be confined to the area designated and approved for disposal and reuse. They further imply that additional medical care should be furnished to workers, protective clothing should be provided, and harvesting operations at times may be delayed. These guidelines do not at this time have the force of law, but it is possible that the appropriate agency may translate them into regulations or permit requirements in the future.

Sprinklers have been suggested as a mitigation measure for certain problems. They also have drawbacks, one of which is energy consumption. For example, Baier, et.al. (1975) estimate that the use of sprinklers will increase power consumption an additional 476 to 544 kwh per acre. The second drawback is in increased labor costs, ranging from $1.50 to $32 per acre per year, depending upon the capital investment, which ranges from $17 to $97 per acre per year. Average total costs of sprinklers over gravity methods are estimated to be $30 per acre per year in 1973 dollars (Baier, et.al., 1975). These estimates are national averages. The small farm sizes and labor intensiveness of agriculture in the Castroville area indicate that added costs would be on the high end of the range for this area, probably well above the $30 average for total costs.

Nighttime sprinkling has been suggested as a mitigation for leafburn from salts. Such measures decrease the effective operating time of sprinklers, and thereby increase the capital investment required, probably by a factor of 2. Night irrigation provides a small increase in efficiency of water use, but the savings do not compensate for the reduction in available irrigation time.

Growing tolerant crops has been suggested as a mitigation measure for certain impacts of using sewage effluent for irrgation. Often, growing different crops decreases farm income, usually because the new crop has lower value and/or higher production costs. Farmers therefore would be likely to resist this option.

One of the most important issues involved with using sewage effluent for irrigation is the intangible factor of consumer resistance, especially to the two most important crops in the lower Salinas Valley, namely, lettuce and artichokes. This resistance (if it exists) can be mitigated only over a long period of time by an educational campaign. There are currently many agricultural areas throughout California and the United States that are irrigating crops with wastewater, with little or no public disfavor. However, the crops being irrigated are generally feed, fiber or processed food crops. Large-scale wastewater irrigation of unprocessed food crops (i.e., lettuce, artichokes, etc.) is not currently being attempted in California.

Even though it is assumed that the reclaimed water will be at least as good as required by the State of California Department of Health Guidelines for Use of Reclaimed Water for Spray Irrigation of Crops, there may be resistance to its use by local regulatory agencies.

Seismic Risks

Threat of Interceptor or Outfall Rupture from Seismic Activity. The proposed wastewater interceptor from Monterey to the regional treatment plant site crosses five potentially active faults (demonstrable seismic activity between 200 and 2,000,000 years ago) (Burkland & Associates, 1975). This includes the Navy, Seaside, Ord Terrace, Chupines and Reliz-Rinconanda faults. The first four are intersected between the existing Monterey treatment plant and the southern boundary of Ft. Ord. Interceptor Routes A1, A2, B1 and B2 are crossed in this stretch. All except B2 are force mains; B2 is a gravity line. Their design average dry weather flows are between 10.5 and 13.7 mgd. The Reliz-Rinconanda fault is crossed by the E routes near their junctions with the Salinas River and by the combined D-E trunk as it turns northward just east of Marina. Both pipelines are force mains; the combined line has a design average dry weather flow rate of 28.3 mgd. The E line design average flow rate is 13.07 mgd. The active San Andreas and Palo Colorado-San Gregorio fault zones border the study area on the north and south.

The seismic hazard evaluation of the entire county conducted by Burkland & Associates (1975) identified the most widespread potential for vibration damage, ground rupture and liquefaction to be along the faults mentioned above. The vibration damage and liquefaction potentials are also extensive in the alluvial soils along the Salinas River. Both the Castroville and Salinas interceptors cross the Salinas River. The evaluation did not attempt to estimate the magnitude or probable occurrence of these seismic hazards, only their presence relative to other parts of the county. A reconnaissance geotechnical study of the project area conducted by John V. Lowney & Associates (1976) indicated that the potential hazard to facilities from fault offset is minimal. However, they predicted the area is "likely to be subjected to at least one moderate to major earthquake causing moderate to severe ground shaking during the design life of the project". The treatment plant will be designed to withstand small tremors that might be expected to occur.

Should an earthquake of large magnitude occur along any of the faults that intersect interceptors, or other faults in or near the study area, there is a possibility of rupture of the interceptors. These interceptors are common to all of the alternatives. The rupture of raw sewage interceptors would undoubtedly create a local health hazard and could lead to contamination of surface waters, including Monterey Bay and the Salinas River. This could have an added adverse impact on wildlife utilizing the waters. A pipeline rupture would also temporarily interrupt sewer service to part of the study area. If water lines in the area are ruptured simultaneously, there may be little or no sewage to convey.

The land portion of the ocean outfall planned as part of Alternatives 1 and 166 is located in geotechnical interpretive Zone VI in the Burkland report (1975). This zone indicates a high prevalence of conditions favorable to vibration damage, ground rupture and tsunami damage. Three of the four proposed outfall routes also cross Salinas River alluvial soils. Only outfall route 3 avoids alluvial material. Although the outfall does not cross any known faults, a large magnitude earthquake in the area could rupture the pipe. The public health and wildlife threats would be less than with the interceptors, as the outfall would carry treated wastewater.

A reconnaissance geotechnical investigation of interceptor routes was conducted by John V. Lowney & Associates (1976) to identify specific hazardous conditions and their locations. A similar investigation will be conducted along the ocean portion of the outfall. The Lowney report concluded that the potential seismic hazard to land-based facilities due to fault offset is minimal, but the area is likely to experience at least one moderate to major earthquake causing moderate to severe ground shaking during the design life of the project.

The alternative interceptor and ocean outfall routes analyzed in this report do not provide for significant mitigation of the seismic risks. In order to avoid crossing the five faults mapped along the edge of Monterey Bay, the regional treatment plant would have to be relocated inland or the Monterey interceptor would have to detour inland around the mapped fault traces. This would not necessarily guarantee a lesser seismic risk and could increase costs and energy consumption, depending on what disposal mode is eventually adopted. The coastal location seems most appropriate for ocean disposal of wastewater. The engineering specifications and design of the interceptors should consider the seismic hazards mentioned above, especially with reference to liquefaction and vibration damage. Shut-off valves at intervals along the pipes could be used to isolate ruptures and minimize the size of a spill should damage occur.

Use of Alternate Route 3 for the land portion of the ocean outfall would avoid a crossing of alluvial soils and could therefore institute a minor reduction in the seismic threat to that pipe. Engineering and design specifications should take into consideration the more detailed material being developed by the geotechnical survey on specific land and ocean outfall routes.

Threat of Damage to and Disruption of the Regional Wastewater Treatment Process and Facilities. Seismic events associated with the faults mentioned above could affect the treatment facilities as well as the interceptors. Each of the six alternative treatment plant sites (which are common to all of the project alternatives) being analyzed are within seismic interpretive Zone VI of Burkland & Associates (1975). This zone has a high prevalence of conditions favoring vibration damage and ground rupture during a seismic event. Site 4 also includes an area of seismic interpretive Zone IV which has a lower prevalence of these conditions (see Figure 28 and Table D-2 for details). Analysis of this general information indicates that Site 4 may therefore offer the best chance of avoiding seismic damage to the regional treatment plant. Site specific geotechnical evaluations now being conducted will better define the hazards on each site.

The threat of seismic damage to treatment facilities does not vary greatly between the various project alternatives. Generally speaking, however, the less complex the treatment system, the lower the risk of seismic disruption. Alternatives 1 and 171 have relatively simple systems, while Alternatives 134 and 170 require storage ponds and pump-back equipment. Alternative 166 lies somewhere between these two groups. Ranking of treatment facilities from most likely to least likely to receive seismic damage is therefore 170, 134, 166, 171 and 1.

If the treatment processes were interrupted but the plants continued to receive untreated wastewater, the small emergency storage reservoirs designed into Alternatives 134 and 166 would offer the least damaging interim disposal method. If the damage were major, requiring an extended period of plant closure, discharge through an outfall to the ocean might be more desirable. Bypassing to the large storage reservoirs of Alternatives 134 and 170 would create local odor problems and would probably require re-treatment of the entire contents of the reservoirs. Bypassing raw sewage to the percolation ponds of Alternative 171 would create odor problems and could lead to contamination of the groundwater mound used for agricultural irrigation.

In order to mitigate these potential hazards to treatment facilities, the results of the detailed geotechnical evaluation now in progress should be utilized to site and design the regional treatment plant. If serious seismic hazards are found on all of the proposed treatment plant sites and design specifications do not appear to be adequate to reduce the hazards, other sites should be investigated.

Tsunami Hazard. The Monterey Bay coastline has experienced minor tsunamis in the past. None of the alternatives would place treatment facilities immediately along the coast where future tsunamis would pose a threat, but treatment plant sites 3 and 6 could conceivably be affected by run-up from an extremely large wave moving through the mouth of the Salinas River. Each of these sites has elevations of from 10 to 20 feet above sea level and are at least 1,000 feet away from the river. The tsunami study conducted in Monterey Bay (Garcia and Houston, 1975) did not estimate effects on the river above the mouth, but predicted a 100-year frequency runup of 5.9 feet at the coast. With a 500-year frequency runup of 11.6 feet, tsunami damage to treatment facilities is extremely unlikely.

The ocean outfalls of Alternatives 1 and 166 and to a lesser extent the lagoon or lower river outfall of Alternative 134 would be more susceptible to seismic sea wave damage. These structures must be designed to withstand liquefaction and vibration hazards related to earthquakes; the tsunami hazard should also be taken into consideration in design.

Mitigation of the tsunami hazard is primarily a structural design matter. Alternatives without ocean outfalls (Alternatives 134, 170, and 171) avoid any significant possibility of tsunami damage to facilities.

Impacts on Air Quality

Production of Noxious Odors from Treatment Facility Operation. The transport and treatment of domestic sewage often creates local odor problems. The gases produced by decomposing organic matter are generally considered an undesirable nuisance at best. Anaerobic decomposition creates the greatest problem. The gases may emanate from vents in raw sewage interceptors, treatment plant headworks, sludge drying beds and digestors, aeration lagoons, or from discharge locations. Treatment process upsets and plant breakdowns often lead to severe odor problems.

The proper engineering design combined with the proper operation of wastewater treatment facilities would control the production and release of odors to concentration levels not detectable beyond the treatment facility boundary. Preliminary design of the project alternatives includes covering of the primary sedimentation tanks to minimize odors from this stage of the treatment process. If standby power generation equipment is installed, there should be no chance of the plant contents reaching an anaerobic (odor producing) condition during a power outage.

As raw sewage will spend considerable time reaching the regional facility, injection of air into all force mains is recommended to prevent anaerobic conditions. Regardless, the plant headworks should be covered to prevent the release of odors as the raw sewage enters the plant.

Secondarily treated wastewater would be stored in open reservoirs in Alternatives 134, 166 and 170. To eliminate the chance of odor production, filtration and partial disinfection should be provided after secondary treatment and prior to pumping to storage. Use of project Alternatives 1 or 171 would avoid the potential odor problems of surface storage. Most of the proposed treatment plant sites are sufficiently remote from residential, recreational, and commercial areas to avoid complaints. Use of the easterly portions of Sites 4 or 5 would be most effective in removing the plant from most human contact. However, if the City of Marina expands northward into the area planned for urban expansion on the Marina Master Plan, a conflict between residential and/or commercial land uses and the treatment facilities could eventually occur. Future planning and development in the area should be designed to avoid this confrontation.

Production of Other Air Pollutants. Operation of equipment and vehicles in and around the treatment plant will generate small amounts of hydrocarbons, nitrogen oxides, carbon monoxide and possibly other pollutants. The amounts have not been calculated, but they should be quite small. Vehicles used on-site should be fitted with appropriate emission control devices to limit production of pollutants. Air pollutants associated with anticipated population increases in the study area are discussed in the Secondary Impacts section.

Public Health Impacts

Possible Biological and Chemical Contamination of Groundwater Supplies. All alternatives which would supply reclaimed water for crop irrigation near Castroville include tertiary (level IV) treatment, which is recognized by the California State Health Department as sufficient treatment for unrestricted irrigation practices (see Appendix O for regulations). The applied irrigation water would be disinfected and would spend a considerable time in the aerobic soil layer, making the chance of any adverse biological change (addition of pathogenic bacteria and viruses) in the groundwater quite small. Numerous studies have indicated that most bacteria and viruses are filtered out in the first few feet of soil mantle (Pound and Crites, 1973; Metcalf & Eddy, 1975; Drewry and Eliassen, 1968). Some areas in the lower Salinas Valley experience seasonal high water tables, but this generally occurs in the winter nonirrigation months. In addition, the surface aquifer is already of poor quality and not generally used for domestic or agricultural purposes.

The possibility of nitrates reaching usable groundwater in the proposed irrigation area of Alternatives 134, 166, 170 and 171 was discussed under groundwater quality impacts. The threat of contamination by various potentially toxic chemicals and stable organic compounds was also discussed in that section.

Alternative 171 represents a unique problem from a public health standpoint. Infiltration/percolation of a secondary treated effluent to groundwater storage allows a probability for biological and chemical contamination of otherwise suitable domestic water supplies. It is felt that for this alternative to be feasible, detailed geologic and hydrologic studies would be required to find a storage area which is already isolated from usable groundwater supplies, or one which could be operated to keep the percolated water distinctly isolated from other groundwater supplies. Preliminary analysis of the probable storage area by Metcalf & Eddy (1975) indicates that it may be sufficiently isolated from the 180-foot aquifer to allow its use for wastewater storage.

The likelihood of contaminating groundwater stores can be kept to a minimum in irrigation areas by strictly maintaining State Health Department wastewater quality standards for irrigation and by managing wastewater application to minimize percolation to the groundwater table. Wastewater application rates should be tailored to soil percolation rates and evapotranspiration. Hydraulic overloading should be avoided. Wastewater irrigation should be avoided in areas where domestic wells still tap the surface aquifer. If necessary, a well-monitoring program could be established to detect any biological or toxic chemical contamination of usable groundwater stores. In areas where leaching of salts from the soil is necessary because of the salt content of reclaimed wastewater, it may be necessary to install tile underdrains to avoid deterioration of surface aquifer groundwater stores still in use.

A lined surface storage reservoir should be included at the regional plant site of all reclamation alternatives to temporarily hold poorly treated or untreated effluent in case of plant malfunctions. Small reservoirs are being planned for Alternatives 134 and 166 for just this purpose. Some efficient means of detecting treatment disruptions must be included to avoid distribution of poorly treated effluent to the irrigation systems.

Reduced Health Hazard in Surface Waters. All five of the major project alternatives would eliminate several existing sources of surface water contamination. Elimination of sewage discharges to Tembladero Slough, the Salinas River (near Salinas) and the nearshore shallow waters of southern Monterey Bay would reduce the level of biological contaminants presently found in those waters. The existing sewage discharges have adversely affected recreational uses in the lower Salinas River, Elkhorn Slough and occasionally the beaches of the southern bay for many years by contributing bacterial contaminants in excess of recommended standards for water contact recreation and shellfishing.

The level and location of health hazard reduction varies slightly among the alternatives. All would eliminate the two City of Salinas discharges to the Salinas River and alleviate a health problem in that area. The existing southern Monterey Bay and Tembladero Slough discharges would also be removed by each alternative. Elimination of the Tembladero Slough discharge, combined with sewering of the Moss Landing and Los Lomas areas, should reduce bacterial contamination of shellfish in Elkhorn Slough. This is highly desirable, as shellfish harvesting is a beneficial use assigned to the slough by the State Water Resources Control Board Water Quality Control Plan. The reduction may not be sufficient to allow harvesting to be reestablished, however. Alternative 1 would concentrate and relocate wastewater discharges to a point over one mile offshore in central Monterey Bay. Little or no water contact recreation occurs in the proposed outfall location. Therefore, it should not create a new health problem. Only if the treatment plant were to malfunction or be disrupted by a natural disaster (earthquake, flood) and discharge untreated wastes would a significant health hazard be created. Oceanographic studies being conducted by the project engineers will provide better information to assess the health risks of this ocean discharge, especially the possibility of ocean currents carrying wastewater back toward shallow water and beach areas.

All of the irrigation reuse alternatives (134, 166, 170 and 171) would result in drainage of some tertiary treated (level IV) effluent to surface ditches and agricultural drains in the Castroville area. These in turn flow into the Salinas River, Old Salinas River and Elkhorn Slough. Disinfection of the wastewater prior to irrigation reuse would reduce total coliform counts to 2.2 MPN/100 ml, however. This is well below the basin plan recreational use standard (200 MPN/100 ml fecal coliform for contact recreation). Elimination of the Castroville discharge and sewering of the Moss Landing area would reduce the public health problems in the Old Salinas River and Elkhorn Slough to a much greater extent than the wastewater in agricultural drainage could increase them.

Alternative 134 creates a slightly different situation in the lower Salinas River and lagoon, and to a lesser extent in Old Salinas River and Elkhorn Slough. In the first stage of development, Alternative 134 would discharge the region's wastewater to the lower river year-round. The upstream Salinas discharges would be removed. The river discharge would contain not more than 2.2 MPN/100 ml total coliforms. Treatment process upsets or plant breakdown could create short-term contamination in excess of this level, but this should be extremely rare, as an emergency storage reservoir is provided in this alternative. If second stage development of Alternative 134 occurs (irrigation reuse), summer discharges to the lower river would be infrequent, but winter discharges would continue.

The coliform count contained in the discharge would be low enough to meet basin plan water contact recreation standards (200 MPN/100 ml fecal coliform) and the State Department of Health standard for unrestricted recreational impoundments (2.2 MPN/100 ml, California Administrative Code, Title 17, Section 8047). Currently, the RWQCB does not consider water contact recreation a beneficial use in the lower Salinas River, but it is an assigned beneficial use in Elkhorn Slough and the coastal waters of Monterey Bay.

In summary, the Alternative 134 discharge of wastewater (level III or V) to the lower Salinas River would have lower bacterial and viral concentrations than the existing surface waters, but could still represent a health hazard to water contact recreationists in the lower river, in Elkhorn Slough, and in nearshore ocean waters in the vicinity of the mouth of the Salinas River if treatment plant malfunctions occur. Other factors (i.e., agricultural drainage) continue to adversely affect the beneficial uses of the lower Salinas River. Therefore, Alternative 134 would not in itself allow complete attainment of the "fishable-swimmable" goals of PL 92-500. The net effect of this alternative, however, would be to improve public health problems in the area's surface waters.

Possible Biological Contamination of Fields and Crops. All of the irrigation reuse alternatives would spread treated effluent on fields and crops in the lower Salinas Valley. Because most of these crops are sold to the public as unprocessed fresh produce and may be spray irrigated, the State Department of Health requires a high degree of water treatment (level IV) prior to irrigation (see Appendix O for reclamation criteria). This level of treatment is deemed sufficient to protect the public from bacterial and virus infection.

The real threat to public health is an undetected failure of the wastewater treatment process, leading to irrigation with heavily contaminated water. The other significant risk is associated with accidental or unknowing drinking (or inhaling) of wastewater in the fields by farm workers. The likelihood of these events occurring is about the same for each of the four reclamation alternatives. Alternative 1 does not include crop irrigation with wastewater.

The possibility of crop contamination and infection of farm laborers could be reduced by utilizing the most reliable treatment system possible and constantly monitoring the quality of reclaimed water transported for irrigation. A system for rapid detection of plant malfunctions and diversion of poorly treated effluent should be established prior to implementation of irrigation reuse. The State Department of Health Wastewater Reclamation Criteria (Appendix O) include these and other system requirements. In addition, the Department of Health guidelines for use of reclaimed water for spray and surface irrigation of crops, and for worker protection at water reclamation use areas (California Department of Health, 1974) should be adhered to at all times (see guidelines in Appendix O). Normal county and state health department monitoring of crop quality should also reduce the likelihood of bacterial or virus-contaminated produce reaching the public.

Increase in Vector Populations. All of the proposed wastewater systems except Alternative 1 could lead to local increases in vector populations. The wastewater irrigation planned for the four reclamation alternatives will not increase vector breeding habitat. The wastewater will simply take the place of well water now used for irrigation. The wastewater storage/disposal facilities associated with Alternatives 134, 170 and 171, and possibly Alternative 166, would be the most likely sources of vector populations.

Alternative 134 requires approximately 120 surface acres and Alternative 170 nearly 900 acres for wastewater storage. Alternative 171 includes up to 185 acres of percolation ponds. These water bodies will provide breeding habitat for mosquitos unless properly constructed and maintained. Some species of mosquitos found in this area have been known to be carriers of several diseases harmful to man, including encephalitis and malaria. Shallow water areas supporting aquatic vegetation are especially conducive to mosquito breeding. The peak breeding seasons are spring and summer.

Alternative 134's reservoir is to be used only for storage during the irrigation season (usually late spring to early fall) and its water level will fluctuate considerably. This will reduce the potential for vector outbreaks. The percolation-infiltration ponds of Alternative 171 will be used year-round and will provide extensive shallow water and puddle environments. These conditions are ideal for mosquito breeding. Periodic drying of these beds is necessary to maintain aerobic soil conditions, however. This will help keep the mosquito populations in check. The large surface reservoir planned as part of Alternative 170 will also be wet practically year-round. It will undoubtedly have an extensive shallow water shoreline and might therefore have the greatest potential for vector problems. Alternative 166 includes an emergency storage pond; it may also be an occasional source of mosquitos.

All of these facilities are planned for the dunelands north of the City of Marina. Should that city expand northward as proposed in the Marina Master Plan (Monterey County Planning Commission, 1967), an urban population would be brought into close proximity to a potential vector problem.

The local mosquito abatement district should be consulted and utilized to monitor and control insect vectors. Reservoir and percolation pond embankments should be sloped at 2:1 or steeper and aquatic vegetation should be discouraged on the perimeters to minimize breeding habitat. Fluctuation of standing water levels will also reduce habitat. Mosquito fish (Gambusia affinis) and other small fishes could be stocked in the reservoirs as an abatement measure. However, 1 ppm of residual chlorine is toxic to these fish. Aeration or short-term intermediate storage of chlorinated effluent prior to discharge to the larger storage/percolation areas could protect the fish. Chemical sprays are also effective in mosquito control but can have undesirable side effects on resident fauna, including extermination of beneficial insect species and gradual bioaccumulation of the chemicals in larger animals.

Elimination of Septic Tank Seepage to Groundwater Supplies. The Facilities Plan calls for eventual hookup of several presently unsewered areas to the regional wastewater system. These include Moss Landing, some parts of Castroville, Prunedale, small developments north of Salinas, and low density development in the Monterey-Salinas corridor. These areas are currently using septic tanks. By eliminating the septic tanks, the possibility of contaminating usable groundwater supplies will be reduced. Groundwater immediately below Moss Landing and Castroville is not being used for domestic or agricultural purposes, as its quality is already poor. The water below Prunedale and the Monterey-Salinas corridor is still being used, however. There are no indications of wastewater contamination in these areas to date, but continued septic tank use could lead to problems.

Impacts on Terrestrial Wildlife and Vegetation

Changes in Riparian Vegetation. Riparian vegetation borders much of the Salinas River in its lower reaches. The vegetation is supported by a groundwater source and surface flows. Surface flows from the USGS gauging station at Spreckels to the Salinas River lagoon maintain some areas of *hydrophyte* and *phreatophyte* vegetation in the stream channels. The elimination of wastewater flows will likely reduce or eliminate the hydrophytes but will probably have little impact on phreatophytes. Much of the lower Salinas River is a "losing" river with more subsurface than surface flow. Phreatophytes (most riparian species) typically derive moisture from the subsurface water source. To what degree wastewater flows contribute to the underflow of the river is not known; however, it is unlikely that the elimination of wastewater will significantly alter subsurface flows.

Under natural conditions (pre-wastewater discharge and pre-dam construction), much of the lower river was dry during the summer months. This was due to a number of factors, including the lack of rain, and the extensive percolation capacity of the Salinas Valley floodplain. This lack of water probably had a limiting effect on riparian growth, and in fact, during abnormally dry periods, vegetation dieoff probably occurred.

The introduction of wastewater discharges and numerous small agricultural diversions, and the regulation of downstream flows by Nacimiento and San Antonio Dams have altered the natural flow regime. Those changes plus the effects of agricultural runoff have influenced growth of riparian vegetation along the river.

Figure 38 depicts the known and likely existing sources of water to the lower Salinas River. While it is obvious that the Salinas sewage treatment plants contribute to the surface water, there are other point and nonpoint sources that will remain unaffected by the regionalized sewage system. They will continue to contribute water to the river and to support riparian growth.

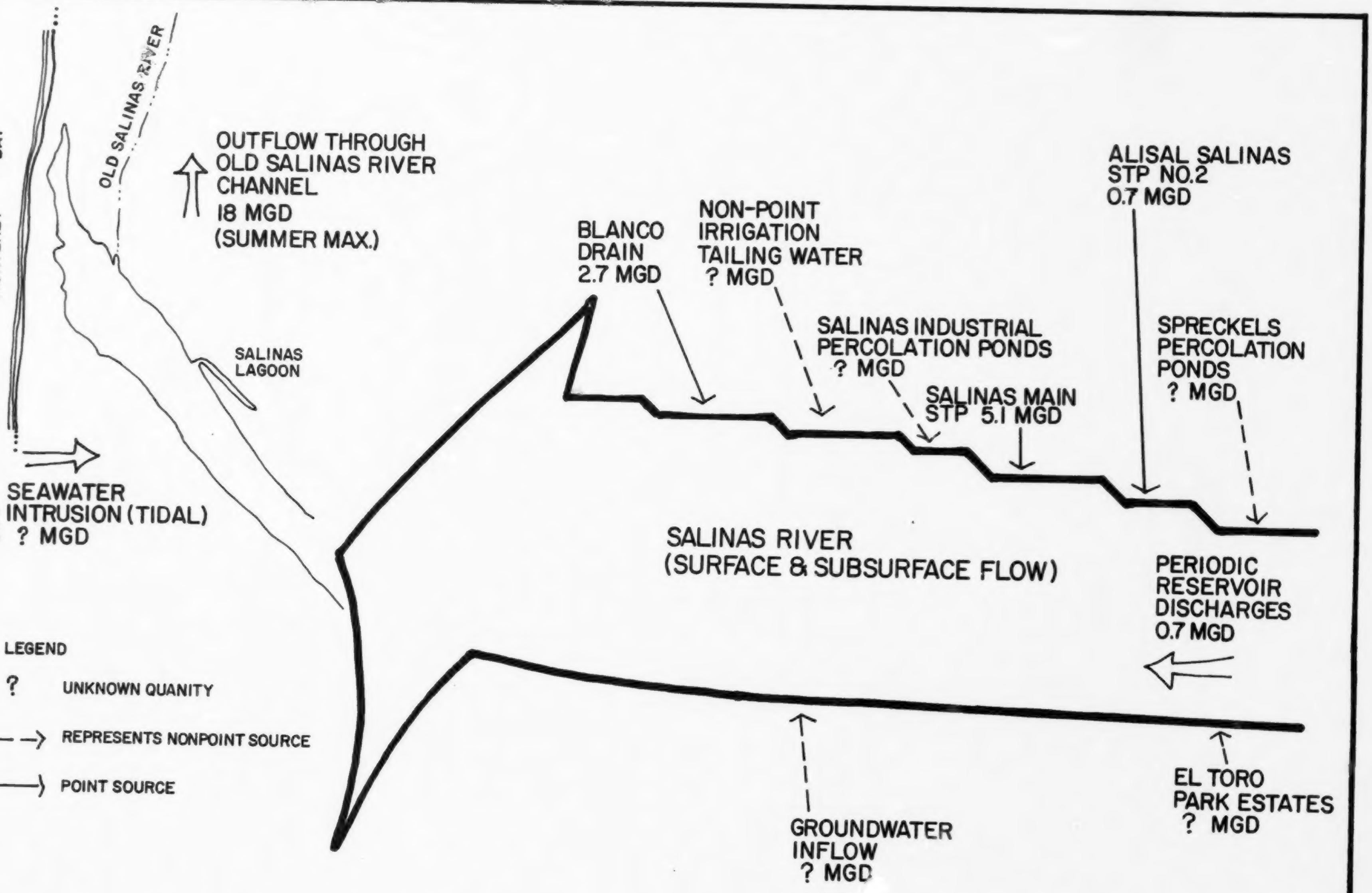

MONTEREY BAY
OLD SALINAS RIVER
OUTFLOW THROUGH OLD SALINAS RIVER CHANNEL 18 MGD (SUMMER MAX.)
SALINAS LAGOON
SEAWATER INTRUSION (TIDAL) ? MGD
BLANCO DRAIN 2.7 MGD
NON-POINT IRRIGATION TAILING WATER ? MGD
SALINAS INDUSTRIAL PERCOLATION PONDS ? MGD
SALINAS MAIN STP 5.1 MGD
ALISAL SALINAS STP NO.2 0.7 MGD
SPRECKELS PERCOLATION PONDS ? MGD
SALINAS RIVER (SURFACE & SUBSURFACE FLOW)
PERIODIC RESERVOIR DISCHARGES 0.7 MGD
GROUNDWATER INFLOW ? MGD
EL TORO PARK ESTATES ? MGD
LEGEND
? UNKNOWN QUANITY
--> REPRESENTS NONPOINT SOURCE
—> POINT SOURCE

FIGURE 38 POINT AND NON-POINT LOW FLOW (JUNE–SEPTEMBER) SOURCES OF WATER TO THE SALINAS LAGOON

Any impacts on riparian vegetation could be reduced or eliminated in part by implementing any of the four potential mitigation alternatives -- 1) retention of summer wastewater flows by the City of Salinas sewer treatment plant; 2) pumping effluent via pipeline to discharge into the river; 3) develop a wellfield to pump groundwater to the river; and 4) release additional water from San Antonio or Nacimiento Reservoirs. If flows from any of these sources are less than existing wastewater flows, there will likely be a minor impact on hydrophytic plants now growing on the fringes of the wetted perimeter of the streamway.

Impact on Terrestrial Wildlife. Any vegetation changes resulting from the reduction of wastewater flows in the Salinas River will directly affect attendant wildlife. The reduction of streamflow can cause a change in quantity of habitat and wildlife, or a change in quality and distribution of vegetation and attendant wildlife. Virtually no information exists regarding the downstream streamflow requirements for wildlife (U. S. Fish and Wildlife Service, 1976).

The reduction of streamflow could affect vegetation and wildlife in the following ways:

a. Remove drinking water for terrestrial birds and mammals.
b. Directly affect "aquatic" wildlife such as beaver or muskrat by eliminating the water environment they rely on for protection.
c. Lowered water tables can alter riparian vegetation, eliminating essential elements of habitat for some wildlife species.
d. Changed patterns of flooding may affect willows or marshes dependent on flood water for maintenance.

Only the first two of these are direct; yet they are not likely to be of major importance unless all flow in the river is stopped completely.

Item c, the reduction of water table and subsequent alteration of riparian vegetation, is not likely to represent a major impact of wastewater flow elimination. Riparian vegetation is supported almost exclusively by subsurface supply and therefore will not be substantially affected. Those wildlife species dependent on hydrophytic vegetation will be affected by the elimination of wastewater flows and any subsequent elimination of vegetation in the river. This would be true of all alternatives except the no action alternative. Those species most directly affected will include amphibians such as red-legged frog, pond turtle and water-related bird species including the heron species, the marsh wren and waterfowl species.

All alternative schemes except no action will cause a small reduction in lagoon water surface area during the summer due to the reduced flow in the river. Such a reduction in lagoon area will likely reduce the amount of summertime waterfowl and shorebird habitat, thereby impacting wildlife populations. The degree of this impact is judged to be minor.

During the summer months the lagoon habitat impacts associated with Alternative 134 will be the same as mentioned above. However, the discharge of 20 (anticipated 1980 average dry weather flow) to 87 (ultimate peak wet weather flow) mgd of wastewater into the lagoon during the high flow winter months should be a benefit to wildlife using the area, particularly waterfowl, which are more dependent on winter rather than summer conditions in the lagoon.

The implementation of any of the four major mitigation alternatives proposed will reduce or eliminate the previously mentioned impacts on terrestrial wildlife, and would likely improve habitat conditions in the Salinas lagoon because of the increase in freshwater flows.

Changes in Vegetation Adjacent to Salinas Lagoon. None of the proposed alternatives will likely cause substantial changes in the vegetative cover adjacent to the lagoon. Virtually all of the vegetation in the lower lagoon is salt grass (Distichlis spicata), pickleweed (Salicornia virginica) or other salt-tolerant plant species. Although salinity increases are likely to occur in the lagoon during the low flow months, the impact on vegetation is expected to be insignificant.

The vegetative composition is determined by the salinity of soils and the salinity of water flooding the soils during the spring months. The lagoon is generally open to the ocean during those critical months and tidal waters flowing into the lagoon raise the salinity of the water to the extent that only *halophytes* can exist.

Alternative 134 will add from 20 mgd (projected average dry weather flow of 1980 population) to 87 mgd (ultimate peak wet weather flow) of wastewater into the lower river and lagoon during the high flow winter months. Under normal year conditions, 20 mgd of wastewater would be almost double average December streamflows, would contribute approximately 30 percent to average January flows, 8 percent to February flows and 11 percent to March flows. Such increases in freshwater flow would increase the winter time gradient between fresh and saline water in the lagoon and probably have a positive effect on reducing soil salinities on lands surrounding the lagoon. The higher projected flows for later years will be of an even greater influence.

With a reduction in soil salinities, vegetative composition may change to more beneficial wildlife plants such as fathen (Atriplex patula) and brass buttons (Cotula coronopifolia). These plant species are a better source of food for the water birds that are heavy users of the wetlands in and around the lagoon.

Impacts on Warmwater and Estuarine Fisheries

Reduction of Warmwater Fisheries Habitat. An impact common to all alternatives, except the no action alternative, will be the elimination of existing wastewater discharges to the Salinas River from the present Salinas Main and Salinas-Alisal treatment plants. The elimination of these discharges will reduce existing warmwater fisheries habitat during the low flow months in approximately 5.5 miles of stream. During the normal dry months of May to October or November and in dry years, the two Salinas plants provide 75 percent of the streamflows from the USGS gauging station to the Salinas lagoon, and 90 percent of the flow from the gauging station to the Blanco Drain.

The existing 9-10 cfs (6 mgd) of wastewater is at times adequate to support a warmwater fishery consisting primarily of carp, suckers, and several other species. Periodic fish-kills during the dry season have been observed in the river, probably caused by toxic conditions and low dissolved oxygen. This poor quality of water during the low flow periods is a major limiting factor to the quality of the stream fishery.

The elimination of wastewater flows will also cause a reduction in stream fisheries habitat from the Blanco Drain to the Salinas lagoon. Flows are projected to be reduced by 75 percent to approximately 3 cfs during the low flow months and dry years. Such flow reductions will likely affect resident fish populations by causing a rise in salinity in the upper reaches of the lagoon and by reducing the extent of surface water in the river above the lagoon. Species sensitive to high salt levels will have to move further upstream in the lagoon. Total numbers of fish in the river itself will decrease due to the reduced size of the surface water habitat.

The reduction of flows is not expected to affect upstream movements of steelhead trout, since the migrations are primarily dependent on adequate downstream flows for the total length of the Salinas River, not just flows below Spreckels. The winter upstream migration is supported by normal winter streamflow accretion (from rainfall) and by a 10 cfs release from Nacimiento Reservoir made by the California Department of Fish and Game through a working agreement with the City of San Luis

Obispo. *Anadromous fish* cannot navigate the Salinas River until these sources of water create adequate surface flows in the entire length of the river. Neither San Antonio nor Nacimiento Reservoirs have their own winter flow release programs for anadromous fish (Jones & Stokes Associates, Inc., 1976).

The greatest impact on warmwater fisheries will occur during the months of June through October when streamflows are at the lowest point. Flows during the remaining months should be adequate to provide fishery habitat from Spreckels to the lagoon even in the absence of wastewater flows.

The regionalization of wastewater systems proposed in all alternatives will also eliminate existing wastewater flows from the Castroville Sanitary District's plant to Tembladero Slough. These flows amount to 0.34 mgd (0.5 cfs) and represent only a small percent of flows in the slough. The impact of flow elimination on fishlife is expected to be insignificant.

As was mentioned earlier, the two Salinas sewage treatment facilities represent the only point source discharges to the Salinas River in the study area above the Blanco Drain. However, it is likely that nonpoint sources contribute some water to the river. These flows may originate or be influenced by: 1) the El Toro Park Estates sewage treatment facility, 2) Spreckels percolation ponds, 3) the Salinas industrial percolation ponds, and 4) irrigation return flows from agricultural operations adjacent to the river. All of these sources will likely continue to provide some water to the river, either as underflow or surface flow. Upon termination of the Salinas wastewater discharges, these nonpoint sources will represent the only sources of water to the river from Spreckels to the Salinas lagoon.

A number of possible mitigation schemes have been identified for the maintenance of both summer streamflows and the warmwater fishery in the lower Salinas River and the Salinas lagoon. The four methods considered most feasible include: 1) retention of a direct river discharge by the City of Salinas (from existing plant); 2) pumping effluent from the regional facility back to Salinas and discharging into the river during the summer months; 3) developing a wellfield and diverting pumped groundwater to the river; and 4) releasing additional quantities of water from Nacimiento or San Antonio Reservoir.

Maintenance of direct river discharge by the City of Salinas would ensure that existing habitat was maintained since summer discharge volume would be the same as present. For all other alternative schemes, the question of water quantity would require calculation and legal agreement (see Significant Issues to be Resolved section). All of these mitigation schemes would maintain the 5.5 miles of stream fishery habitat now maintained by the 6 mgd of wastewater from the existing treatment plants. Such mitigation measures would totally or partially offset projected impacts (depending on quantity and quality of flow to be released) on terrestrial wildlife and vegetation and warmwater and estuarine fisheries expected with Alternatives 1, 166, 170 and 171.

The negative aspects of maintaining a Salinas wastewater plant discharge are: 1) the necessity of maintaining a wastewater treatment plant in Salinas; 2) the failure to eliminate all wastewater discharges (and their health problems) to the river; and 3) the reduced volume of reclaimed wastewater that would be available for crop irrigation through the regional system.

There are no major environmental benefits in using flow augmentation from effluent piped upstream from the new regional plant when compared to the other options, except that the existing Salinas treatment plant could be eliminated. This would eliminate the local aesthetic and occasional nuisance odor problems caused by the treatment plants in Salinas. The adverse environmental implications of this mitigation method include the need for construction of an additional pipeline from the treatment plant and a reduction in reclaimed wastewater being provided to an irrigation reuse system (assuming an irrigation reuse option is selected). The pipeline construction would create short-term impacts along the pipeline route; the significance of the impacts would fluctuate with the route chosen. The decrease in reclaimed wastewater being provided to irrigation would reduce the benefits reclamation might have on the local water supply and salt water intrusion problems.

Pumping groundwater to maintain dry-weather flows in the lower Salinas River would have several benefits. First, long pipelines and additional treatment facilities would not be needed to provide the flow. The location of the facility could also be quite flexible. The existing Salinas treatment plants could be eliminated, and the area could tie into the regional wastewater system. In addition, the flow source would be of a fairly constant and reliable volume and quality. There would be no possibility of accidental discharges of toxic materials to the river.

The use of groundwater for flow augmentation carries with it several potential problems. The 180- and 400-foot aquifers in the Salinas Valley are presently being overdrafted and intruded by salt water. Additional pumping from these aquifers will increase these problems. However, if the surface aquifer, which is seldom used due to its relatively high mineral content, could be used as a source for flow augmentation, the pumping should have little effect on usable groundwater supplies.

Flow augmentation from increased upstream reservoir releases would allow Salinas to tie into the regional wastewater system, thereby eliminating the existing Salinas treatment plants and providing the maximum reclaimed water flow to irrigation should an irrigation option be selected for the regional wastewater disposal system. The quality of the dry-weather surface flow in the lower river would also be greatly improved over existing conditions. No pipelines, pumps or treatment facilities would be required beyond those for the regional treatment and disposal.

The shortcomings of this option relate to its operational, legal and political feasibility. There should be no adverse environmental effects. The operational feasibility of additional releases from the upstream reservoirs should be investigated in cooperation with the Monterey County Flood Control and Water Conservation District and the State Water Resources Control Board.

The allowance for a discharge into the California Department of Fish and Game wildlife area at the mouth of the Salinas River would represent a means of partially mitigating for impacts on wildlife upstream if none of the four aforementioned instream release mitigation alternatives were implemented. Such a discharge would have the potential of improving the quality and increasing the quantity of marsh habitat. Quality of the wastewater discharge may have to meet the SWRCB and EPA standards for contact recreation use, as the wildlife area is open to the general public for hunting and fishing. The quality requirements should be further investigated prior to implementing this mitigation measure. Any of the project alternatives (except no action) could initiate such a discharge to the wildlife area, but some means of conveyance from treatment plant to marsh would be necessary. Alternatives 1 and 166, with ocean outfalls passing through or near the wildlife area, would be most suited for instigating this mitigation.

Effects on Fisheries Resources of Elkhorn Slough or Moss Landing Harbor. The regionalization of wastewater systems proposed in all alternatives (except no action and Alternative 134) will eliminate all wastewater flows now entering Elkhorn Slough and Moss Landing Harbor from Tembladero Slough and from the Old Salinas River.

The elimination of wastewater flows to Elkhorn Slough will improve the quality of habitat for estuarine fish and shellfish, particularly in those areas now greatly impaired by pollutants. The reduction in freshwater or brackish water flows to Elkhorn Slough and Moss Landing Harbor will have an insignificant effect on the fish resource.

Under the no action alternative, impairment of estuarine fishlife in Elkhorn is expected to continue.

Alternative 134 (irrigation and lower Salinas River or lagoon disposal) will cause an increase in flows in the Old Salinas River and into Moss Landing Harbor during the spring, winter and fall months in the early years of operation. Summer flows are not expected to increase significantly during the summer irrigation period unless the decision is made not to use wastewater for irrigation. In later years (2000) the expected increases in wastewater volume may go beyond the needs for irrigation and flows may then increase during the summer months.

Such flow increases may change fisheries habitat in portions of Elkhorn Slough and Moss Landing Harbor by creating a salinity gradient. This situation may cause a reduction in the marine organisms and a shift to the more freshwater-tolerant species. This entire impact could be negated, however, if the decision was made to close the tide gate between the Old Salinas River channel and Elkhorn Slough, thereby eliminating freshwater flows into the harbor.

The implementation of any of the four major mitigation measures mentioned earlier would reduce the impacts on fisheries resources of Elkhorn Slough by continuing freshwater flows into the Salinas lagoon and Old Salinas River. Those flows would not be equivalent to existing flows entering Elkhorn Slough from Tembladero Slough and Old Salinas River.

Changes in Estuarine Fisheries Habitat. The elimination of wastewater flows from the two Salinas sewage treatment plants will create changes in the low flow condition of estuarine fisheries habitat in the Salinas lagoon. This total elimination of wastewater would occur with Alternatives 1, 166, 170 and 171. Alternative 134 (irrigation and lower Salinas River or lagoon disposal) would provide tertiary treated wastewater to the lower Salinas River and lagoon. Under present conditions, sources of water to the lagoon include sewage wastewater, annual runoff from the Salinas River watershed, agricultural return water, salt water from Monterey Bay and water from several nonpoint sources.

These sources of water have varying influences on the quality of the lagoon water throughout the year. The size and diversity of the estuarine fishery is dependent greatly upon the quality of the lagoon water. Water quality dictates the range of species present and the relative number of individual fishes to be found. In general, when turbidity and temperature increases and dissolved oxygen levels decrease, the range of species and number of individuals decreases. During the low flow months, lagoon water quality is poor, with algal blooms, oxygen depressions and toxic conditions commonplace. The TDS and specific conductance of the water during that time is dependent on the amount of freshwater inflow from agricultural water and sewage effluent and from the tidal conditions.

The elimination of sewage flows will likely cause a reduction in the extent of the ponded areas during low flow months. This impact would be common to all alternatives assuming that wastewater is utilized for irrigation. Such flow reductions will probably cause an increase in the TDS and specific conductance of lagoon water during the low flow summer months since under present conditions the sewage effluent tends to dilute the more saline agricultural wastewater and intruded Monterey Bay water. The increases in salinity will reduce the habitat for freshwater fish species and improve the habitat for marine and estuarine fish species.

The effect of eliminating sewage flows on fishes during the high flow winter months will be negligible even though all alternative schemes except Alternative 134 will eliminate those flows. This minor impact is due to the fact that during the winter months normal stream accretion and reservoir releases provide improved habitat and sufficient water in the lagoon (Department of Water Resources, 1965). During periods of high flows, Alternative 134 will discharge tertiary-treated wastewater (level III or level V) into the lower Salinas River or lagoon. If Alternative 134 discharges to the lower river in periods of low flow, these discharges should decrease the TDS and electrical conductance of the water in the lagoon and improve the habitat for warmwater and anadromous fish.

Impacts on Monterey Bay Biota

At this time the exact location of possible ocean outfall is yet to be determined and the predesign study of the possible impact of an ocean outfall on the marine environment is therefore in abeyance. However, several possible routes for the line and locations for the outfall in Monterey Bay have been proposed (Figure 32). Four possible routes have been considered; all of them would enter the bay just south of the mouth of the Salinas River, and the outfall would be located between the 60- and 100-foot contours. Available information suggests little difference between the outfalls proposed for these four alternative routes as far as potential impact on bottom fauna and plankton is concerned, and the selection of a final approved route will probably be governed more by length of pipe and problems of routing across land, dune fields and marsh areas, and highway and rail line crossings. The four suggested outfall sites would, as indicated, be at about the same depth. They were originally located along the 120-foot contour and spread over an 8,500-foot stretch. Alternatives 1 and 4, however, ended at about the same location in the bay; outfall 2 was about 4,000 feet south of these, and the last, Alternative 3, was situated south of these, and the last, Alternative 3, was situated 4,500 feet south of #2. Subsequent engineering work has resulted in Engineering Science, Inc. recommending use of route 2, but with a significantly shorter route and shallower terminus. Pending a more detailed study of current patterns in this area, it would seem better to consider the outfall sites farthest from the river mouth as potentially the least likely to cause problems. This is simply in view of the potential silt load and possible storm drain overflow of materials from the Salinas River during periods of high rainfall, which might augment the effect of the proposed ocean discharge. It is proposed that the outfall line would be in a deep trench, emerging at about a depth of 30 feet in the bay, and covered from that depth out to the end of the pipe. The surface would be covered to a sloping contour with rocks and sand, thus reducing the possibility that it would act as a barrier to movement of benthic and demersal organisms moving about in the vicinity of the pipeline.

Secondary treatment is proposed for this combined discharge, which would produce effluents of the quality indicated as level 1A (Table K-1). This treatment would reduce total coliform counts to 1,000 MPN/100 ml. Other than meeting public health requirements, the significance of this level of coliform bacteria to marine organisms is as yet inadequately understood. Some marine organisms, including oysters, thrive in what are polluted environments, according to public health standards. This treatment level does not, however, remove many of the other constituents of wastewaters such as those indicated in Table K-2 under "other data". With respect to trace metals, the concentrations in the wastewater generally exceed those in ocean water, (see Table 40). The initial 100 to 1 dilution the wastewater is supposed to receive upon entering the ocean should slow trace metal buildup in the immediate vicinity of the outfall, spreading it over a fairly large area.

The effect of trace metals on marine benthic invertebrates is not well established. Studies conducted in the Southern California Bight indicated there was no apparent increase in trace metal concentrations in invertebrates living in sediments with high metals concentrations. Nor was there an increase in metals concentrations in fish that were feeding on these invertebrates (Southern California Coastal Water Research Project, 1973).

The effects of the new discharge on fisheries is also difficult to assess. There would probably be a change in fish populations and species diversity in the immediate vicinity of the outfall. Those species tolerant to or attracted by the freshwater source will remain in the area, while other less-tolerant species will move away. The net result would be a decrease in diversity with possibly an increase in numbers of certain species. No estimates are available on the possible size of the zone of effect, but it is likely to be extremely small, as there is expected to be considerable dilution of the effluent. The outfall should have little or no influence on the overall distribution of fish in the bay. The species commonly caught in the area are rockfish, halibut, sand dabs, white croaker and salmon.

In the analysis of ocean outfalls in southern California, it appeared there was a correlation between wastewater discharges and a fin erosion disease in several species of fish. The causal factors of the disease were unknown, however, and the effluent discharging to the area received only primary treatment (Southern California Coastal Water Research Project, 1973). The predesign oceanographic survey and post-project monitoring requirements of the SWRCB and RWQCB are designed to identify potential hazards to marine life so that remedial action can be taken. This could include relocation of the outfall site, change in level of treatment, or selection of a different disposal method. These survey and monitoring requirements are also designed to establish a baseline against which changes due to the ocean discharge can be measured.

One benefit of a diffuser system outfall is the development of growths of benthic invertebrates on the outer surface of the exposed end of the pipe. This is brought about by a sort of micro-upwelling, or entrainment of nearby water by the rising effluent. This is not, of course, a direct response to the quality of the effluent, but to the mechanical process set in motion by the effluent water, although this confusion is evident in some popular explanations of the development of epifauna on outfall pipes.

Impacts on Land Use

Conflicts with Adjacent Land Uses. Many of the project's impacts on land use are associated with construction of facilities and the indirect stimulus of growth. These impacts are discussed in other sections of the report. Operation of wastewater facilities generally affects only those lands adjacent to treatment and disposal/reuse sites. All of the proposed treatment plant sites are located in open space/agricultural areas. Their use would have little effect on existing adjacent uses.

Facilities located on Sites 1, 4 and 5, and urban expansion of the City of Marina, could eventually come into conflict. This could be avoided by selecting one of the other treatment plant sites or by using part of the garbage and refuse disposal site in the northeastern part of Alternative treatment plant Site 4. It is unlikely that urban development will encroach on this area.

The storage reservoirs needed for Alternatives 134, 166, 170 and 171 would probably be located on treatment plant Site 4. This would also conflict with urban expansion planned by Monterey County (1967) for the area unless the reservoirs could be confined to the landfill property. Selection of a nonstorage wastewater system would avoid this impact. There appear to be no other feasible sites for storage areas in the vicinity, so relocation to avoid the impact is not likely. A possible conflict could also be avoided if the county would allow only compatible land uses (i.e., agricultural, industrial) to occupy the land within Alternative Site 4.

Impacts on Public Services and Facilities

Water Supply. The operational impact of the proposed regional wastewater system on the size of the local water supply was described in an earlier section. The following impact relates to the provision of water.

Relocation of the Area's Reclaimed Water Sources. All of the proposed project alternatives will relocate the treatment of north Monterey County's domestic wastewater to a single location near the mouth of the Salinas River. The proposed location for the regional plant facilitates the supply of treated wastewater to farming operations near Castroville. This appears to be the best single place to eventually reuse all of the area's wastewater, thereby having the most beneficial impact on the regional water supply situation. Communities and individuals drawing water from the Salinas River groundwater basin would receive the benefit.

This relocation could preclude wastewater reuse in the Monterey Peninsula and adjacent coastal areas, which are also experiencing local water supply problems. These areas may not be able to benefit their own domestic water supply situations by supplying existing nondomestic uses (golf course and park irrigation, noncontact recreational lakes, etc.) with wastewater. This could be remedied by maintaining local treatment plants or installing small package plants to treat part of the local waste flow even after construction of the regional system. The Monterey Peninsula cities are already investigating this possibility. The water supply benefit could also be shared by negotiating a water rights exchange. Portions of or all of the Castroville Irrigation District's rights to Nacimiento and San Antonio Reservoir water could be transferred to other entities in exchange for the reclaimed wastewater. Some or all of the extra reservoir releases planned as part of the Castroville Irrigation Project could be diverted to other areas (the peninsula or coast) for domestic use rather than the Castroville Irrigation District for agricultural use. The legal, political and operational feasibility of a water rights swap has not yet been thoroughly investigated.

Liquid Waste Treatment and Disposal.

Centralization of Liquid Waste Treatment and Disposal. As stated above, all of the alternatives will combine north Monterey County wastewater treatment and disposal to a single system under a single wastewater agency. This will remove the responsibility of providing the service from the incorporated cities involved, from Ft. Ord, and from the existing county sanitation districts within the service area. Local jurisdictions will probably be responsible only for maintaining the internal wastewater collection systems. This should improve the efficiency of liquid waste management in the area.

Elimination of Eight Local Wastewater Treatment Facilities. All of the proposed alternatives would eliminate the need for eight existing wastewater facilities, including two at Salinas, and one each at Pacific Grove, Monterey, Seaside, Ft. Ord, Marina and Castroville. The abandoned plants may be razed and their various parts salvaged, or they may continue to treat small flows for local reuse (golf course or landscape irrigation, recreational water). They could also be converted to other uses.

The regional system could also eventually replace a number of small privately-owned and operated wastewater systems (Tables J-7 and J-8). This will depend upon the ability of the private plants to meet the 1977 and 1983 discharge requirements of PL 92-500 and RWQCB policy.

Operational Reliability of Liquid Waste Treatment Processes. Although all secondary and tertiary processes being considered have been installed and operated satisfactorily at numerous other locations, it can be generally stated that the more complex and greater in number are the treatment processes utilized, the lower the overall system reliability. Also, the less an alternative relies on intermediate pumping in the treatment process, the higher is the operational reliability. Based upon these criteria, Alternatives 1 and 171 provide a high, and essentially the same, treatment reliability. The remaining three alternatives provide the same level of tertiary treatment, but 134 and 170 require pumping of partially-treated wastewater to intermediate storage. Based upon these considerations, it appears that the treatment process reliability of the alternatives ranks as follows (from most to least reliable): 1, 171, 166, 170 and 134.

Operational Reliability of Disposal Facilities. All of the alternatives are capable of meeting the existing and proposed waste discharge requirements. However, the various wastewater disposal modes being considered have varying abilities to provide an environmentally safe means of disposing of untreated waste should the treatment process be interrupted for some reason. Those alternatives with sealed storage or flow regulation reservoirs (Alternatives 134, 166 and 170) can provide a reliable, safe disposal location in emergencies of short duration. Disposal to the ocean (Alternative 1) or to percolation ponds (Alternative 171) is less desirable, as water quality would be degraded and public health hazards could result. If plant malfunctions or shutdowns of long duration occur, none of the possible disposal modes would be completely acceptable. There does not appear to be a significant difference in disposal reliability in this latter regard.

Dependence on an Agricultural Irrigation Distribution System. Although four of the five alternatives are dependent on an irrigation distribution system for wastewater reuse, it must be recognized by the reader that the only system in the planning stage is the Castroville Irrigation Project (CIP). In order to make the CIP economically feasible, a 4-3/8 percent interest rate loan on 35 percent of the project and an interest free loan on the remaining 65 percent of the project is required from the U. S. Bureau of Reclamation. This loan has been applied for but to date has not received approval. In addition, the CIP must be approved by the Monterey County Board of Supervisors. Since Alternative 1 does not require construction of an irrigation distribution system, it is not affected. Although Alternatives 134 and 166 each have a means of disposal other than irrigation, deletion of this reuse from these alternatives change 134 into a total river disposal alternative that might require a higher summertime level of tertiary treatment (level V as contrasted to level IV) and Alternative 166 would be changed into Alternative 1, with deletion of the requirement for tertiary treatment (level IV). Thus, two alternatives (170 and 171) are totally dependent on an irrigation project, two others (134 and 166) become totally different alternatives if irrigation is not implemented, and Alternative 1 is not affected by irrigation proposals.

This reliance on the CIP or some other project can be eliminated if construction of an irrigation distribution system is made part of the reclamation alternatives (134, 166, 170 and 171). The total cost of these alternatives would be increased, but irrigation reuse could be implemented regardless of the status of other projects. The location of the irrigation system could also be selected independently of other projects. Other reuse options could also be investigated to avoid reliance on a major agricultural irrigation system. These are discussed in some detail in the Alternative Projects section.

Potential Discharge of Septic and Untreated Wastes Should an Employee Strike, a Major Equipment Malfunction or Other Unforeseen Events Occur. In general, the more sophisticated the treatment process and/or the more the system depends on pumping, the greater the possibility of an adverse impact due to a major equipment malfunction, a power outage, or an employee strike. All pump stations must be designed with standby pumping capabilities and standby power generating capability to be utilized in the event of the failure of any of the installed equipment or a disruption in normal power supply. Thus, a major malfunction of pumping equipment would not put a pumping station completely out of operation. The treatment facility must also have standby power generating facilities capable of operating the plant in the event of a complete power outage.

Those alternatives which employ tertiary treatment (134, 166, 170 and 171) and/or intermediate pumping to storage (134 and 170) would be most susceptible to an employee strike. This is not to suggest that activated sludge secondary treatment is easy to operate, but only that it would be easier for supervisory personnel to operate during a strike than a more complex tertiary plant.

Change in Personnel Requirements to Operate Facilities. At the present time, 42 people are required to operate the 8 existing treatment facilities. Implementation of the various proposed alternatives would alter the wastewater treatment personnel requirements somewhat. Engineering Science, Inc. (pers. comm.) has estimated that a minimum of 33 personnel would be needed to operate Alternative 166 facilities in its initial year of operation (1981-1982). This includes 1 person for each of the pump stations. Exact requirements for the other alternatives have not been calculated, but generally speaking, the more sophisticated the treatment facility the higher the personnel requirement. Alternatives 134 and 170 would probably have requirements similar to Alternative 166. Alternatives 1 and 171 may require slightly fewer operators.

Solid Waste Disposal.

Sludge Production and Disposal. The sludge which would be produced can be divided into two categories: 1) digested and partially dewatered primary/secondary sludge; and 2) dry, recalcined lime sludge from tertiary treatment. The dried, digested primary/secondary sludge would be identical in quantity in all alternatives. This sludge makes an excellent soil conditioner, and every effort should be made to utilize it on city parks and other public areas, as well as agricultural land. If such uses cannot be developed to utilize the entire amount produced, the excess sludge would be trucked or piped to the Marina sanitary landfill (a Class II landfill with a 50-70 year useful life). The sludge production should range from approximately 41,610 tons per year in 1990 to 46,415 tons per year in the year 2000 (assumes 8,770 pounds of wet sludge per mgd).

Tertiary sludge would be produced in Alternatives 134, 166, and 170. The sludge produced is a dry, recalcined lime material which would be reused or transported to the Marina landfill. The quantity produced is dependent on the amount of flow processed by tertiary treatment, the expected quantities being shown as follows:

Alternative/Year	Tons/Year 1990 (25.41 mgd)	 2000 (29.28 mgd)
134	5,496[1]	6,333[1]
166	5,496[1]	6,333[1]
170	9,553[2]	11,004[2]

[1] Assumes tertiary treatment for 7 months of the year with a tertiary sludge production of 2,060 pounds/mgd (Battelle Memorial Institute, 1974).

[2] Assumes tertiary treatment of all wastewater with a sludge production of 2,060 pounds/mgd.

Power.

Increased Energy Consumption in Collection, Treatment and Disposal of Domestic Wastewater. Table 33 in the Alternative Projects section lists the expected electrical energy requirements of the project alternatives. These consumption rates represent an increase over existing rates, primarily in raw effluent pumping and advanced wastewater treatment. Currently, seven of the major wastewater treatment systems in the study area are using about 12,000,000 Kwh per year for collection and treatment of wastewater. This excludes Ft. Ord, as numbers were not available for their system. The regional system proposed by the project engineers (Alternative 166) would utilize 14,693,000 Kwhs per year for major interceptor transport and treatment. This does not include energy used for pumping in the local collector systems. Even though an exact increase cannot be estimated, it is apparent that the new regional treatment system would use considerably more electrical energy than present systems.

In all alternatives, the influent sewage pumping requirement is identical. The principal deviation in energy requirements results from the need for tertiary treatment and effluent pumping in some alternatives. Alternative 1 requires only slightly more energy than no action would, and is the least directly consumptive of any viable alternative. Alternative 171 requires slightly more energy than Alternative 1, and Alternatives 166 and 170 require slightly more than Alternative 171. The Alternative 134 requirement is substantially greater than all of the others. The tertiary treatment alternatives require natural gas to recalcine lime sludge produced in coagulation, and the no action alternative requires gas for incineration at the Monterey plant. (The projected energy consumption figures used in this comparison have not been adjusted to reflect the proposed use of methane to run regional treatment plant facilities. They represent total energy requirements.)

These demand increases should have no direct effect on the supply of power to local residents, businesses or industries. There are numerous mitigation measures capable of reducing the system's power demands, however.

The methane gas generated by sludge digestion at the regional wastewater treatment facility is to be used as fuel to heat the sludge digestors. The rural location of the probable treatment plant site does not facilitate supply of the plant's excess methane for home or industrial heating. It may be used to run other plant systems, however. If alternative treatment plant Sites 4 or 5 are used for the regional facility, it may be possible to tie the plant's excess methane into the proposed methane recovery system at the adjacent Marina landfill. The Monterey County Solid Waste Management Plan (Munson, 1976) anticipates that an active methane recovery program will exist at this landfill site sometime between 1990 and 2000. The possibility of supplying the combined treatment plant-landfill methane to PG&E should be investigated as another option. In the interim, other treatment plant uses for excess methane should be encouraged.

The electrical consumption of the system as a whole can be kept to a minimum by selecting those interceptor, treatment plant location, and treatment and disposal alternatives with the lowest expected energy requirements. Energy-efficient pumps and motors should also be utilized. Selection of the most energy-efficient system may require undesirable environmental trade-offs, however. The treatment plant locations investigated in detail were selected primarily on the basis of land availablity, adjacent land uses and probable location of disposal or reuse. The treatment and disposal methods being investigated are designed to meet state and federal water quality and public health requirements. These considerations may outweigh possible energy saving from other locations or types of systems. Nonetheless, electrical energy must be considered in this environmental evaluation as a nonrenewable resource with limited supply, as the fuels consumed to produce the energy are of a nonrenewable nature (i.e., natural gas, fuel oil).

Aesthetic Impacts

Possible Elimination of Eight Existing Treatment Plants. All of the proposed project alternatives would eliminate the eight major wastewater treatment plants in the study area. Many people find such facilities to be aesthetically undesirable and therefore their removal is generally considered beneficial. This is especially true where the facility is near residential or recreational areas. Dismantling of the coastal plants and their ocean outfalls (Pacific Grove, Monterey, Seaside, Ft. Ord, Marina) would enhance the scenic value of the Monterey Bay coastline and the nearshore waters of the bay. Removal of the two Salinas plants would improve the scenic qualities of both developed (Alisal plant) and developing (Salinas main plant) parts of the City of Salinas. Elimination of the Salinas plant river discharges would reduce the noxious odors and algae blooms that occur below the outfalls in periods of low river flow, improving the scenic and recreational value of the Salinas River. From another viewpoint, elimination of discharge, which could result in a total lack of flow in the lower stretches of the river during dry periods, would reduce the aesthetic value of the river. Dismantling of the Castroville plant would remove treatment structures from a predominantly open, agricultural landscape.

Introduction of a Large Wastewater Treatment Facility into a Predominantly Open Landscape. Each of the five project alternatives includes a single, large wastewater treatment facility near the mouth of the Salinas River. This area is presently open land supporting agricultural pursuits, solid waste landfilling, and a limited amount of recreation. The six treatment plant sites being considered are in close proximity to one another, but have varying degrees of visibility to passers-by and therefore slightly different potential visual impacts. The treatment facility itself will occupy 40 to 50 acres of land. If placed on Sites 1, 2, 3 or 6, it would be readily visible from both the present and new routes of State Highway 1. This section of highway is included on the state's scenic highway master plan, but has not yet been officially designated as a scenic route. A treatment facility on Sites 4 or 5 could be placed so that only persons driving along the Marina landfill access road might see it. If constructed on Site 4 adjacent to the landfill, the treatment plant would have little effect on the area's aesthetic quality.

Use of low profile structures, subdued natural colors and construction materials, and sufficient landscaping could reduce the visual impact of the treatment plant complex. Construction of a low berm around the facility would also minimize the impact.

Storage reservoirs planned as part of Alternatives 134, 166, and 170 and percolation-infiltration ponds required for Alternative 171 would be located in the rolling terrain of alternative treatment plant Site 4. The water level in these facilities would be subject to extreme variation and the ponds may at times be dry. This altered landscape might be considered aesthetically unpleasing to some people, although tree planting and shrubbery on the perimeter could substantially lessen the impact.

If urban development expands northward from the new City of Marina in the future, aesthetic problems associated with the regional wastewater treatment facility may be greatly increased. Residential and commercial interests are frequently allowed to encroach upon aesthetically detracting areas until complaints from occupants force curtailment or removal of the earlier established use. Once the regional treatment facilities are located and constructed, land use plans and zoning in the area should be structured to avoid such a conflict.

Resource Use

Chemical Consumption. Chemical requirements for the treatment and disposal alternatives are shown in Table 34. All alternatives have been described as using chlorine for disinfection and all in essentially the same quantity, except Alternative 1, which requires less disinfection prior to discharge to the ocean. Other methods of disinfection have been considered; they are described in the Alternative Projects section of this report. The three alternatives requiring tertiary treatment (134, 166 and 170) require lime or alum as a coagulant; therefore, they have a higher yearly consumption of other chemicals when compared to the secondary systems of Alternatives 1 and 171.

Chemical consumption can be reduced by using other treatment and disinfection methods. Ozonation, when used as a substitute to conventional tertiary wastewater treatment, can cut coagulant (lime or alum) and disinfectant (chlorine) requirements significantly. Small-scale prototype ozonation tests conducted by James M. Montgomery, Consulting Engineers (1975) indicated alum dosage could be cut from 140 mg/l to 10 mg/l and chlorine dosage from 8 mg/l (post-filtration) to 2 to 4 mg/l when substituting an ozonation-coagulation-flocculation-filtration-chlorination treatment train for the standard chemical coagulation-sedimentation-filtration-chlorine disinfection process. The large-scale effectiveness of ozonation is not yet well-documented, however, and it requires a large energy input. The energy consumed in producing chlorine (3,000 Kwh/ton [California State Water Resources Control Board, Energy Task Force, 1974]) and coagulant would be reduced if ozonation were used. The savings on chlorine production alone could range from 456,600 to 684,900 Kwh per year in 1980. This must be balanced against the additional energy needs for the ozonation process itself, however. No specific estimates have been prepared for this contingency in Monterey County, but in a similar wastewater project in Chino, California, energy consumption at a 24 mgd plant was expected to more than double if the conventional tertiary treatment processes were abandoned in favor of ozonation (Jones & Stokes Associates, Inc., 1975).

Land treatment and ocean disposal options would reduce chemical consumption when compared to the tertiary treatment alternatives. Use of land treatment would eliminate the alum or lime requirement and ocean disposal would reduce the chlorine requirement (see Table 34). Some forms of radiation are also used as disinfectants. Particle, electromagnetic and acoustic radiations have been used to sterilize water, but usually on a small scale. These methods eliminate the need for chemical additives, but require additional sophisticated equipment not normally used in wastewater treatment plants.

Electrical Energy Consumption. The electrical energy requirements of the various interceptor routes and treatment and disposal processes are listed in Table 33. Additional discussion and listing of mitigations is included under "impacts on Public Services and Facilities-Power".

Noise Impacts

Local Increase in Noise Near Pump Stations and Treatment Plant. All five of the project "action" alternatives (1, 134, 166, 170, 171) would require operation of several pump stations along the new wastewater interceptors and a new regional treatment plant. New pump stations would be located near the Seaside treatment plant at Aldy Way, near the intersection of Reservation Road and State Highway 1 in Marina, and at Nashua Road near State Highway 1, just south of Castroville. Existing structures would be used to house pumps at the Monterey, Salinas main and Castroville treatment plant sites. All of the pumps would be run by electrical motors which would be in operation at all hours. Noise levels generated by unenclosed electrical pumps vary greatly with the type and size of pump and no estimates of probable levels were found. Backup pumps run by gas driven internal combustion engines would probably produce noise in the 65 to 75 dBA range at 50 feet (U. S. Environmental Protection Agency, 1971) if unenclosed. (Figure 39 lists typical sound levels and human responses for comparison with these dBA estimates). It is expected that the new pump stations would be constructed underground and the pumps at Monterey, Salinas and Castroville would be in existing structures. The noise from the pumps should therefore be sufficiently insulated to avoid any significant impact on adjacent human or wildlife inhabitants.

The variety of pumps, engines and other mechanical equipment used at the new regional treatment plant site would also generate noise. It is difficult to predict the eventual noise levels generated by the fully operating plant, but if

Weighted Sound Levels and Human Response [1]

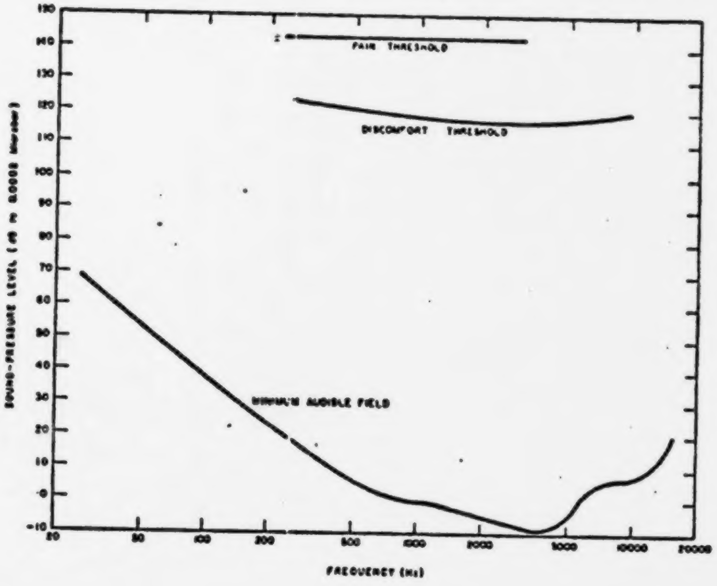
Sound Source	dB (A)*	Response Criteria
	150	
Carrier Deck Jet Operation	140	
		Painfully Loud
	130	Limit Amplified Speech
Jet Takeoff (200 feet)	120	
Discotheque		
Auto Horn (3 feet)		Maximum Vocal Effort
Riveting Machine	110	
Jet Takeoff (2000 feet)		
Shout (0.5 feet)	100	
N.Y. Subway Station		Very Annoying
Heavy Truck (50 feet)	90	Hearing Damage (8 hours)
Pneumatic Drill (50 feet)		
	80	Annoying
Freight Train (50 feet)		
Freeway Traffic (50 feet)	70	Telephone Use Difficult
		Intrusive
Air Conditioning Unit (20 feet)	60	
Light Auto Traffic (50 feet)		
	50	Quiet
Living room		
Bedroom	40	
Library		
Soft Whisper (15 feet)	30	Very Quiet
Broadcasting Studio	20	
	10	Just Audible
	0	Threshold of Hearing

*Typical A—Weighted sound levels taken with a sound-level meter and expressed as decibels on the scale. The "A" scale approximates the frequency response of the human ear.

Figure 39

HUMAN TOLERANCE AND RESPONSE TO SOUND LEVELS

THRESHOLDS OF HEARING AND TOLERANCE[2]



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[1] U. S. Council on Environmental Quality. 1970. Environmental Quality. The First Annual Report of the Council on Environmental Quality. 326 pp.

[2] Benarde, Melvin A. 1970. Our Precarious Habitat. W. W. Norton & Co., Inc., New York. 362 pp.

pumps and engines are adequately housed and dampened, levels should not exceed the 45 to 55 dBA range. All of the proposed treatment plant sites are sufficiently remote from residential and recreational areas to eliminate the likelihood of serious off-site noise complaints. The plant's internal noise could be kept to a minimum by vibration isolating pumps and motors, installing acoustical filters designed for specific pumps and motor speeds, and enclosing pump and drive units in acoustical enclosures (U. S. Environmental Protection Agency, 1971a).

Noise Reduction in the Vicinity of Abandoned Plants. Noise levels in the vicinity of abandoned treatment plants would decrease slightly. The impact would be quite minor, but operational noise at the Marina, Ft. Ord, Salinas-Alisal and Seaside plants should cease. Pumps would remain in operation at the Monterey, Salinas main and Castroville plants, but other operational equipment would no longer be used.

Flood Hazard

The U. S. Geological Survey (USGS) mapping of flood-prone areas within the study area was conducted on a general level. Before the specific flood threat can be identified and declared official for flood insurance purposes, the U. S. Army Corps of Engineers must review and verify the USGS mapping. This has been done within the Cities of Salinas, Monterey and Seaside, but not within the remainder of the study area. This impact analysis is therefore general in nature and should be re-evaluated when the detailed mapping is complete.

It appears that there is no flood threat to any proposed wastewater facility specifically designed for one project alternative. Those facilities planned within the flood hazard area (as currently mapped) are interceptor pump station facilities common to all project alternatives. The interceptors from both Salinas and Castroville must cross flood-prone areas. The Salinas line crosses the Salinas River floodplain while the Castroville line crosses the floodplains of Tembladero Slough, Alisal Slough and the Salinas River. If properly constructed and buried, there should be no significant threat of flood damage to those lines. There are no feasible alternative interceptor routes that would avoid a crossing of the mapped flood-prone areas.

The proposed Castroville sewage treatment plant pump station (see Figure 30) is located within the flood-prone area mapped along Tembladero Slough. A low berm exists around a portion of the Castroville treatment plant, but it is not known what degree of protection this affords.

A more detailed analysis of the flood threat at this site should be conducted prior to final design of the interceptor system. If it is within the 100-year floodplain, steps must be taken to protect the proposed pump station from flood flows. Construction of a berm may be sufficient. If not, it may be necessary to relocate the pump station to a higher elevation. The federal government will not fund facilities proposed within the officially-designated 100-year floodplain unless given assurances that they can be protected from flooding.

Economic Impacts

Service Costs

The following economic impact analysis focuses on the alternative recommended in the Facilities Plan (#166), as a detailed revenue plan has been developed for this alternative by Bartle Wells Associates (1976). The other project alternatives would have similar types of impacts, but the dollar amounts would vary with the difference in construction and operation costs (see Table 27).

Financing the Cost of the Project. The direct economic effect of the proposed project is its cost, estimated at $71,400,000 for the alternative recommended in the Facilities Plan (at the time of construction in 1980). Of this, the local share would be about $10 million, with the difference financed by federal installations in the area ($9.5 million) and federal and state grants.

Financial consultants to the MPWPCA (Bartle Wells Associates) have recommended that a regional county sanitation district be formed. This agency would call a bond election to authorize the sale of bonds for financing local capital costs. Either revenue bonds (which require authorization by a simple majority vote in a bond election) or general obligation bonds (which require a two-thirds majority vote) would be acceptable alternatives, according to the financial consultant. To finance the local share of $10 million, the bond principal amount would be about $12 million for general obligation bonds or about $14 million for revenue bonds. The higher amount would provide interest during construction for the revenue bonds as well as a reserve fund that would be required by bond covenants. Bartle Wells has recommended that authorization to issue $18 million in bonds be sought, which would cover cash flow deficits during the construction period as well as financing the local share of capital costs.

User Costs. The California State Water Resources Control Board (SWRCB) has established guidelines for wastewater agency revenue programs (SWRCB, September 1974a). Under the procedures stipulated, Bartle Wells has prepared estimates of user charges which would recover stage II costs of the wastewater facilities system. These charges include user charges and connection fees. Both are estimates and are subject to adjustment pending preparation of a final revenue program, which must be submitted for approval prior to receipt of more than 80 percent of state and federal grant payments. (Additional cost data in Appendix M.)

Service Charges. The regional agency does not plan to levy a property tax. Instead, user charges would be made. Each participating agency would also have a system of charges to cover the cost of operating and maintaining its local collection system. Equalization payments by the regional agency to the local agencies would cover some of this local cost. Local collection systems' costs are not included in the user charges set forth below.

Regional system industrial users would be charged on a formula basis, which would consider both quantity of flow and strength of effluent, based on BOD and suspended solid loadings. Initial estimates indicate that industrial users would provide about 2.7 percent of the estimated total $5 million annual user charge revenues.

Non-industrial users would be charged either a flat rate or a quantity charge based on metered water use. Flat rates would provide about 66.3 percent and quantity charges would provide about 10.8 percent of all user charge revenues. Bartle Wells (1976) preliminary revenue plan indicates that total regional service charge for a single-family residence would be about $54 per year (4.50 per month). The annual charge for apartments (individual dwelling units in multi-family structures) would be about $33 (2.75 per month). It is important to note that these figures are only preliminary at present.

The revenue and expense projections assume that federal installations (Ft. Ord in particular) will prepay the initial cost of capital facilities and will pay an annual charge based on a pro-rata share of operation and maintenance costs including replacement. (Negotiations must be conducted to determine the method to be used by the federal installations to finance their share on a timely basis.) Federal installations would provide about 9.4 percent of all user charge revenues.

Connection Fees. About 10.8 percent of all user charge revenues would be provided by connection fees. Revenue from these fees is projected at $560,000 per year, based on 700 single-family equivalent connections per year. The charge would be set initially at $800 and escalated $50 annually. Bartle Wells characterizes this income as "uncertain" as it is entirely dependent on new connections to the system. If connection charges generated only half of the projected annual income, or $280,000, user charges would have to be increased accordingly.

Property Values. An impact on major investment in public infrastructure may be to cause an appreciation in property values. This is particularly the case where, in the absence of public investment, the land cannot be developed or the intensity of existing development cannot be increased. Such circumstances may exist within the project area, although (as discussed in the chapter on secondary impacts which follows) it does not appear that the no-project condition would pose a severe impediment to future growth in the area.

The incidence of property value increases, to the extent that they may occur, would be determined more by the local services agencies than by the establishment of a regional facilities system per se. Responsibility for construction and maintenance of collectors would remain local; local capital programming and budgeting decisions will continue to establish timetables for service extensions to presently unserved areas.

This combination of factors suggests that the establishment of a regional wastewater system in the project area would not markedly affect property values; differences in values arising from the distribution of service would persist whether or not a regional system is implemented.

Effect on Economic Growth. Regionalization of major sewerage and wastewater treatment facilities may have a supportive impact on future economic development. Major industrial and office employers typically consider the extent, reliability and cost of public services as one factor in their location decisions. The establishment of a regional system incorporating up-to-date treatment processes would remove any doubt potential future employers would have with regard to this particular issue. However, Monterey County has not historically been a rapidly developing employment area and the role of a regional wastewater facility in altering this historical pattern, if any, would be minimal.

Impacts of No Action Alternative

The no action alternative is choosing not to proceed at the present time with any of the proposed wastewater system alternatives described and analyzed in the preceding sections. The wastewater treatment plants now in existence would continue to operate individually, using the same basic treatment and disposal methods currently employed. There are actually two perspectives from which this option can be analyzed. The first analysis considers the consequences of continuing treatment and disposal in exactly the same manner now practiced. The second analysis considers the impact of adjusting treatment and disposal methods at each individual plant in order to meet the requirements of PL 92-500 and RWQCB discharge requirements.

The major consequences of continuing existing operations, without any adjustment, are as follows:

1. Failure to implement any significant water reclamation scheme that might relieve the existing water shortage and reduce the serious overdrafting of the Salinas Valley groundwater basin.
2. Continuation of existing public health hazards and wastewater degradation in the Salinas River, Moss Landing-Elkhorn Slough and nearshore waters of southern Monterey Bay.
3. Possible future public health hazards created by discharges from overloaded treatment facilities, and in some cases, inadequate ocean outfalls. Problems with existing discharges were summarized in the Environmental Setting section (Public Services and Facilities).
4. Failure to comply with deadlines established by the Federal Water Pollution Control Act (PL 92-500) regarding discharge of pollutants to the surface waters of the United States.
5. Failure to comply with the goals and objectives of the SWRCB's _Water Quality Control Plan Report - Central Coastal Basin_.
6. Failure to comply with RWQCB waste discharge requirements. This could result in the issuance of cease and desist and cleanup orders and ultimately levying of fines of from $6,000 to $10,000 per day.
7. Maintenance of existing warmwater fishery in the lower Salinas River and continuation of periodic fishkills from toxic or low oxygen conditions.

The major impacts likely if each individual treatment plant is improved to meet the PL 92-500 and RWQCB discharge quality requirements and enlarged to handle projected waste flows are as follows:

1. Failure to implement any significant water reclamation scheme that might relieve the existing water shortage and reduce the serious overdrafting of the Salinas Valley groundwater basin.
2. Possible creation of occasional health hazards in the lower Salinas River, Moss Landing Harbor, Elkhorn Slough and the nearshore waters of southern Monterey Bay from discharge of partially treated or untreated wastewater to these shallow water environments.
3. Possible failure to receive federal-state Clean Water Grant funding for necessary facilities improvements, with resultant high local costs for wastewater service. Adoption of a wastewater facilities plan that does not appear to comply with policy established in the SWRCB's basin plan may result in the withdrawal of federal-state financial support of the project. The entire cost of the project would then be borne by the local agency and local residents.
4. Maintenance of existing warmwater fishery in the lower Salinas River and improvement in the river's water quality.
5. Failure to comply with the recommendations of the SWRCB's Water Quality Control Plan Report - Central Coastal Basin.

The economic impacts of these no action options would most affect persons living in the study area. Cost of wastewater treatment could become a major service expense rather than a minor one (as is now the case) if fines are levied for non-compliance with federal law and RWQCB discharge requirements. Fines of $6,000 to $10,000 per day can be assessed for violations of discharge permits. The likelihood of government sanctions being incurred if treatment systems do not meet PL 92-500 or RWQCB standards is impossible to assess, however. In the absence of financial sanctions, "no action" may have no significant economic impact. The health problems associated with the individual outfalls would continue to restrict use of the area's surface waters. Considering that there are relatively inexpensive means to improve the area's wastewater service and at the same time benefit various segments of the local environment (i.e., surface water quality, water supply), the no action alternative is not an environmentally acceptable option.

SECONDARY IMPACTS

Introduction

"Secondary Impacts" Defined

Construction and operation of a wastewater treatment and disposal system may have direct and immediate impacts on a host of natural phenomena; these impacts have been described in the preceding chapter. "Secondary impacts" is the term embracing the indirect or induced effects of a project. These impacts may be experienced in all the areas in which primary project impacts are anticipated; that is, the natural environment, land use and population, resource allocation and economic activity. They are the outcome of changes in the pattern of use of land and natural resources for which the project can be seen as the sole or contributing cause.

For example, wastewater service extension may remove an impediment to development of previously vacant land. When the project is completed, that land may be developed. Secondary impacts could conceivably include population growth, changes in land use, disturbance of the natural environment, alteration in resource consumption patterns, and changes in the visual/aesthetic environment. Because these effects are indirect, they may be more difficult to identify and quantify than are direct effects. As a rule, they can be described in terms of type, location and the extent of development which a project area will experience as an indirect consequence of implementation of a wastewater project.

The volume of growth which an expanded wastewater facilities system may serve is important, but estimating the numerical population increase attributable in some degree to the system is not the sole consideration from the environmental perspective. What the EIS must consider is what burden an increase in population may impose on the environment. This burden may differ depending on the form and location of new development. Changes in travel patterns (i.e., travel distances to and from work; for shopping and for recreation), availability of and demand for public utilities (such as water) and services (such as roads), resource consumption involved in land preparation and construction, the foregone benefits of the prior land use -- these and other characteristics of development can vary widely depending on the type and location of development.

Growth is not per se an evil, but it can have undesirable consequences if it takes place in an environmentally irresponsible manner. Thus, the analysis of secondary impacts must consider the relationship between projected growth and the region's environmental resources -- land, air quality, water quality, energy, aesthetics, and wildlife.

The Methodological Approach

In evaluating the environmental consequences of growth in the project area, reference has been made to the extensive work already undertaken by various public agencies within the region and throughout the state.

No independent population forecasts were undertaken by the socio-economic consultant, Gruen Gruen + Associates (GG+A), in connection with this study. The consultant utilized data assembled by the facilities engineers, Engineering Science, Inc., and data provided by Monterey County and the Monterey County Transportation Study. Existing forecasts and comprehensive plans prepared by cities in the region, conferences with local planning officials and relevant data and projections by state agencies supplied inputs to the work. The focus of demographic analysis was on the consistency between population forecasts prepared by various agencies and 1) regional economic forecasts and 2) local plans.

This chapter reviews the dynamics of growth in the region to provide a background for considering the secondary environmental impacts of the project. Possible relationships between population growth and wastewater facilities are explored. Finally, secondary impacts of alternative potential projects on a series of key environmental factors are evaluated.

Dynamics of Growth

Population growth in the Monterey Peninsula and lower Salinas Valley over the 20-year study period will arise from several sources and will be subject to numerous constraints. The existing population is expected to be augmented over time by natural increase and in-migration. A significant proportion of in-migrants will be military personnel.

Population growth may be increased or its rate accelerated by improvements in those features or conditions which attract households to the area and support new development. These would include: 1) increases in the supply of housing; 2) provision for adequate public services, including water, sewers and roads; 3) availability of employment opportunities; and 4) preservation of environmental assets.

The amount of population increase can be diminished and the growth rate reduced by constraints on development. The type and rigorousness of constraints may differ from place to place. Possible constraints include limitations on the availability of resources to construct new housing or to provide new development with essential services. For example, in areas already heavily developed, the lack of additional vacant land hampers further growth. Where groundwater forms the basic supply of that resource, new construction can be delayed or precluded if sufficient water cannot be provided from on-site wells.

Constraints may also be imposed as a matter of public policy. The State of California has imposed or may impose inhibitions on development on certain types of land, such as prime agricultural land, land lying within the coastal zone or land in mapped floodplains. To these may be added the limitations and restrictions established by local government: subdivision controls, zoning ordinances and annexation policies which can affect the type, scale and timing of development.

Public action can sometimes be taken to remove or impose a resource constraint -- such as building a dam in response to a water shortage or denying building permits if environmentally-acceptable wastewater treatment and disposal facilities are lacking.

This section describes the sources of population growth pressures the region will experience and the types of constraints which will affect the volume and rate of growth.

Pressures for Growth

Natural Increase/New Household Formation. The excess of births over deaths is the "natural increase" of the population. As the offspring of present residents in the study area reach the age at which they want to form their own households, they may seek new or existing housing units in the same area as their parents. Data for the U. S. as a whole indicate that the recent high level of housing demand will continue until the late 1980's because the large number of people born in the 1950's are now just entering the housing market.

In-Migrants. In addition to present residents and their children, there are several other market segments drawn to the project area who will comprise a force for population growth. Both young adults and the retired are drawn to the region, often by its natural beauty and pleasant weather. Young adults can find employment in entry-level jobs in tourism, while the retired live on their savings and on income from pensions and Social Security. These groups have both been important in past population increases in the project area.

Recent Census Bureau research indicates that the retired are increasingly moving to rural and mountain areas and away from the so-called "sunbelt". San Luis Obispo County is the only county on the California coast which experienced, between 1960 and 1970, a 15 percent or more net in-migration of persons 60 years and older; the other California counties with significant in-migration of older persons are in the rural mountains of the interior. However, even if this recent pattern persists, it will be some time before it will be reflected in the age distribution of cities such as Pacific Grove, now heavily populated by retirees. A predominance of older people in the population can have an effect on wastewater project implementation, not only because in-migration of the retired is an important factor in population growth, but also because this group may be less willing or able to bear the financial burden a project may impose.

The migration of the young to the project area reflects the overall appeal California has had for young Americans. Traditionally, young adults have been more likely to move than any other age group. Among persons aged 20 to 24, migration rates are highest and long moves (inter-county vs. intra-county) form a higher proportion of total moves than for any other age group (Census, 1974). However, longer moves are more likely than shorter moves to be job-related. Thus, youthful in-migrants to the study area might decline if job growth lags.

Military Personnel. The change in the status of Ft. Ord from a training base to a divisional headquarters is expected to have a marked effect on the housing market in the project area. Although the change in the number of military personnel assigned to the base is not expected to be dramatic, the type of person assigned has altered. Formerly, a significant portion of personnel were recruits who lived on the base. Now, a significant proportion are career personnel, including many persons with spouses and children. The influx of military families seeking off-base housing will reduce vacancies and tend to increase housing costs in nearby communities as this transition is effected.

Existing Housing Shortage. The study area is currently experiencing a very low housing vacancy rate, suggesting that new housing construction has not been keeping pace with demand. This phenomenon is not unique to the study area: rising costs of labor, construction materials and money have contributed to a similar situation in many localities. These costs have risen faster than income in the past 5-7 years, so that households whose income would have supported the cost of a given house in earlier years now find that cost too high. As a result, new households have difficulty finding "starter" units, and long-time residents who want to change the size, location or style of their present residences find their choices limited. The influx of military families aggravates this condition of pent-up demand. However, recent (preceding 1-2 years) increases in real income (i.e., income measured in terms of the goods, such as housing, for which it can be exchanged) combined with falling interest rates may indicate the beginning of a new period of intense residential activity, where other circumstances are favorable.

Economic Growth. Forecasts of regional economic growth serve two important purposes in wastewater system planning: 1) estimating future industrial wastewater loads; and 2) verifying indirectly, the population forecast for the region.

An economic base study of the region, if such a study existed, would be the best aid to forecasting employment and economic growth. However, even a relatively sophisticated economic base study is prone to error when a large number of variables are exogenous to the system. This certainly is the case in the project area with regard to government employment (military and civilian employment on military bases, in particular). Further, recent changes in fertility, labor force participation rates of women, and average family size are prompting economists to reconsider long-range economic forecasts for the nation as a whole, so the absence of a definitive forecast for a region is not an exceptional situation.

In the absence of an economic base study, the approach has been to work with existing data and projections. The principal source of forecasts on future employment growth in the project area is the Monterey County Transportation Study (MCTS) whose forecast of 1995 employment was compared to the forecast for the Central Coast Region in Table 17. The MCTS forecast represents a composite of forecasts of local planning agencies throughout the project area. These individual forecasts were undertaken independently and no attempt has been made to determine the inter-jurisdictional consistency of the forecasts with regard either to assumption or methodology.

Instead, the MCTS forecast was reviewed for plausibility in light of past trends and forecasts of future population. Three tests were applied: 1) is the forecast consistent with historical changes in employment in the study area and projections of existing trends; 2) does it reflect overall changes in national employment, particularly with regard to labor force participation rates; and 3) does it appear to be consistent with population forecasts for the region?

The economies of the Monterey Peninsula and the lower Salinas Valley are quite different from one another. The former is more oriented toward service and professional occupations while the latter is traditionally based upon agriculture and related trade and industry. This division is reflected in state Employment Development Department (EDD) data for the project area, which are reported separately for the Salinas Community Labor Market Area and the Monterey Community Labor Market Area. The reporting areas cover the most urbanized sections of the project area, omitting most direct agricultural employment. However, the data form a good time series back into the 1950's, and annual rates of increase between 1960 and 1970 were computed for four industry groups for each labor market area as a means of comparison with the MCTS 1995 forecast. These industry groupings were selected by MCTS for data aggregation purposes; they are retail trade, service, government, and all else, which shall be referred to as "residual".

Salinas Community Labor Market Area. The 1970 employment inventory of the Monterey County Transportation Study counted about 27,000 employed persons in the Salinas urbanized areas, with some 12,000 additional in the northern part of the project area outside the Salinas urbanized area. Neither the MCTS forecast nor interviews with local planners suggest that any major changes are anticipated for the future, either with regard to the structure of the subregion's economy or the traditional scale of operation of the region's economic establishments. Thus, it appears that the lower Salinas Valley, toward the year 2000, will have the same basic mix of jobs and industries as it has today. About twice as many jobs will exist, and these jobs will be more concentrated in and around Salinas than they are at present, with about 53,000 in the Salinas urbanized area and another 10,000 in the study area north of Salinas.

Monterey Community Labor Market Area. Available data for the Monterey area are less amenable to analysis. EDD data for this subregion include Carmel, which is not in the study area. Substantial present military employment complicates forecasting. However, growth rates by industry for the area were calculated and EDD and MCTS data compared and it was concluded that MCTS-implied growth rates for trade, service and government appear to be low. It appears likely that future employment in the Monterey Peninsula will be higher than MCTS has projected, probably lying in the vicinity of 60,000 to 65,000 compared to about 38,000 in 1970.

Relationship Between Population Growth and Economic Growth. Looking forward to 1995, will there be enough jobs in the study area to support the projected population growth? This issue can be addressed by considering historic and implied future employment-to-population ratios. In 1970, according to MCTS data, total employment constituted 41 percent of the project area population. In 1995, the same proportion would be 37.5 percent. Thus, the implication of the MCTS data is for a decrease in the ratio of employment to population. Because such a decrease is extremely improbable, it is likely that either 1) the MCTS employment projection is too low, or 2) the MCTS population is too high. As the projections are, at best, only rough estimates, one cannot disregard the possibility that both of these explanations of the discrepancy between employment and population apply. However, the employment projection is probably responsible for the greater proportion of the discrepancy for several reasons.

Typically, population projections for semi-rural areas such as northern Monterey County relate strongly to estimates of holding capacity: the total number of residents who can be accommodated on the land under physical and regulatory development constraints. Where development patterns are clearly established, which is the case in most areas of the urbanized north county, and where the long-range demand for housing in a region is strong, this approach to estimating future population can be quite accurate.

However, employment forecasts cannot be accurately derived in the same manner. Changes in the industry base of a community, and intra-industry changes in land requirements per employee, may both be beyond the purview of local planners. The demand for land for industrial use can often be satisfied in a number of different local jurisdictions or, indeed, in a different region altogether. As the MCTS employment projections are simply an aggregate of the views of individual local planning departments, these projections have not been informed by any overall evaluation of the region's economic development prospects. With regard to population-serving employment such as retailing, more than one municipality may be counting in their projections the total retail employment of a single needed new shopping center -- or perhaps none has counted that employment. For these reasons, the employment forecast appears likely to be weaker than the population forecast.

As to the improbability of the implied reduction in the ratio of employment to population, such a decrease would be counter to national and local trends. On a national level, the employment-to-population ratio has been increasing over the last several years and it is generally thought that this will be a continuing secular trend. The rising labor force participation rates of women and the young are more than offsetting the declining labor force participation rates of those over 60. OBERS (U. S. Department of Commerce, 1974) projects an upward trend in the employment-to-population ratio for the water resources subarea of which northern Monterey County is a part. Historical (EDD) data for the 1960's indicates that the ratio has been steadily climbing.

One factor which can operate to dampen this trend in a given region is a large net in-migration of persons not in the labor force, such as retired persons. However, the level of in-migration would have to be quite high to offset the observed long-term trend, and as discussed elsewhere, this region does not now appear to be attracting retired persons to the same extent that it did in the last two or three decades.

Thus, the implied decline in the employment-to-population ratio supports the view that the MCTS employment forecast, particularly with regard to the Monterey Peninsula, is on the low side. Rather than a 1995 employment of 111,000, the level is more likely to be about 120,000 (at the present employment-to-population ratio) or higher.

Constraints on Growth

There exist at present a number of constraints on the future growth in northern Monterey County which will affect its rate and magnitude throughout our study period. Some of these are physical constraints having to do with the ability of the land and resources of the region to support urbanization. Others are institutional constraints reflecting environmental and planning concerns.

Public Regulation. Any development taking place within the project area will be subject to review and regulation by affected public agencies. These agencies and their areas of interest and responsibility were described in the section entitled Legal, Regulatory and Institutional Constraints. The aggregate powers of regulatory agencies are such that the timing, form and scale of construction projects are subject to substantial control by public agencies. Such control is exercised for the purpose of maintaining and enhancing certain public values, such as views, densities, adequacy of public facilities, air quality, and so forth.

Increases in processing time and cost of development have been particularly sharp in the last few years at a time during which construction costs were already rising significantly faster than incomes. For the nation as a whole, median money income of families and unrelated individuals was approximately 31 percent of the average new house price in 1970. By 1974, median money income was only 27 percent of the average price of a new house. With each price rise, some households are cut out of the market and pressures for new construction are reduced. Thus, the regulatory process itself has also recently contributed to an overall downturn in construction.

While personal income may again begin to rise in tandem with housing costs, the prospects for a reduction in development regulation and costs appear minimal. The resumption of 1950's style rapid growth is unlikely in the extreme. Residential growth during that decade gained impetus both from a more rapid rate of population increase than is now being experienced and from government policies which encouraged new residential development by subsidizing road construction and other front-end infrastructure costs. As much of this infrastructure cost has been transferred to the private developer, front-end costs have become a significant barrier to the style of rapid residential development which used to be commonplace.

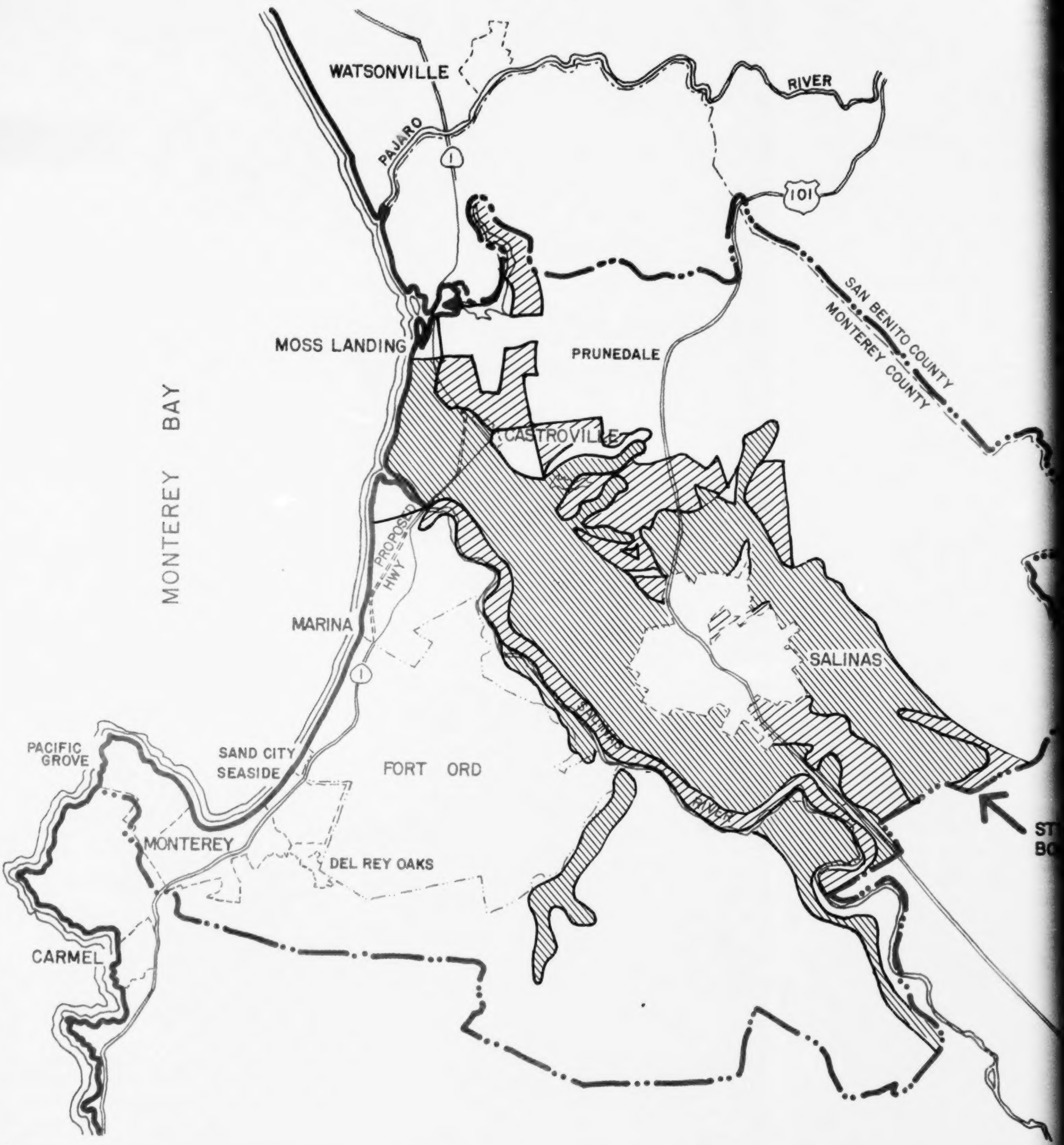
Water Supply. Water supply is presently a growth constraint in much of the project study area. Existing water supply sources and their condition were discussed in the Public Services and Facilities section of the Environmental Setting. It was noted that the Monterey Peninsula supply provided by the California-American Water Company has been grossly inadequate in recent years, stimulating a California Public Utilities Commission building ban in the area. The Salinas Valley groundwater basin, which supplies the entire valley and surrounding low hills, is being seriously overdrafted and intruded by sea water. To date, this has not significantly restricted development; the overdrafting has simply accelerated with local growth. According to Monterey County staff, growth in the north county, including the Castroville-Prunedale area, has accelerated in recent years due in part to the building ban on Monterey Peninsula (Bakeman, pers. comm.). This condition cannot proceed indefinitely, however, without a new source of water.

The adequacy of the water supply may pose a constraint in another major growth center of the project area, the Monterey-Salinas Highway corridor. At the time of interagency reviews of the City of Monterey's Proposed Highway 68 Area Plan in 1975, the Health Department of Monterey County expressed the view that "existing groundwater data for the Highway 68 Area Plan is insufficient for the determination of safe yield" (Wong, pers. comm.).

The Highway 68 Area Plan was developed by the City of Monterey as one in a series of steps to be taken prior to formal annexation of that area to the City of Monterey. The Plan, which was formally adopted by the Monterey City Council on March 16, 1976, sets forth a series of additional steps to be undertaken before any annexation, subdivision or precise zoning can proceed. These include an areawide substrata hydrology study. Also, the council indicated that acceptable responses to possible environmental and infrastructure problems must be made. Pending the outcome of such studies and responses, the adequacy of the water supply to support proposed development (particularly Laguna Seca and Monterey II, which expect to utilize groundwater) has not yet been established.

Land Resources. Urbanization can be inhibited if sufficient reserves of developable land are unavailable. The term "developable" takes into consideration not only the physical capacity of the land (including water supply, slopes, subsoil conditions, etc.) but also the limitations on development imposed by regulatory agencies. For example, development within 1,000 yards (in some cases even further inland) of the coast is subject to the permit authority of the California Coastal Zone Conservation Commission.

Development of prime agricultural land is a matter of concern to local planners and state government. Land in a designated agricultural preserve under the provisions of the Williamson Act must be withheld from development for specified, contracted time periods. Lands in the study area currently subject to Williamson Act conditions are shown in Figure 41. Not all of the Williamson land is prime agricultural land, however, and much of the latter, which is shown in Figure 40, is not in preserve: the agreement to put such land in preserve is not compulsory but is at the initiative of the landowner.


WATSONVILLE
PAJARO
RIVER
1
101
SAN BENITO COUNTY
MONTEREY COUNTY
MOSS LANDING
PRUNEDALE
MONTEREY BAY
CASTROVILLE
PROPOSED HWY
MARINA
1
SALINAS
PACIFIC GROVE
SAND CITY
SEASIDE
FORT ORD
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MONTEREY
DEL REY OAKS
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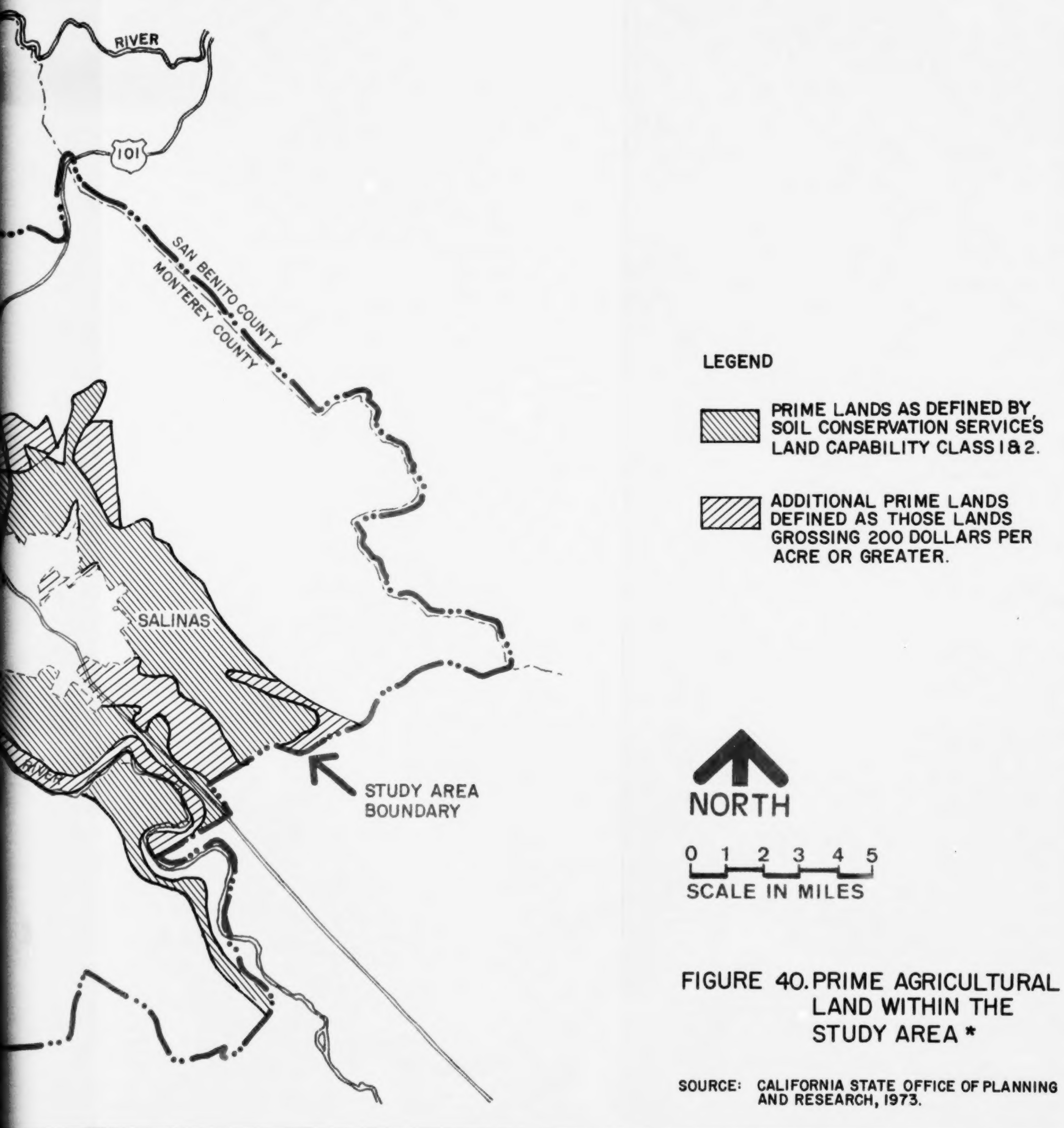

RIVER
101
SAN BENITO COUNTY
MONTEREY COUNTY
SALINAS
RIVER
STUDY AREA BOUNDARY
LEGEND
▧ PRIME LANDS AS DEFINED BY, SOIL CONSERVATION SERVICE'S LAND CAPABILITY CLASS I & 2.
▨ ADDITIONAL PRIME LANDS DEFINED AS THOSE LANDS GROSSING 200 DOLLARS PER ACRE OR GREATER.
NORTH
0 1 2 3 4 5
SCALE IN MILES

FIGURE 40. PRIME AGRICULTURAL LAND WITHIN THE STUDY AREA *

SOURCE: CALIFORNIA STATE OFFICE OF PLANNING AND RESEARCH, 1973.

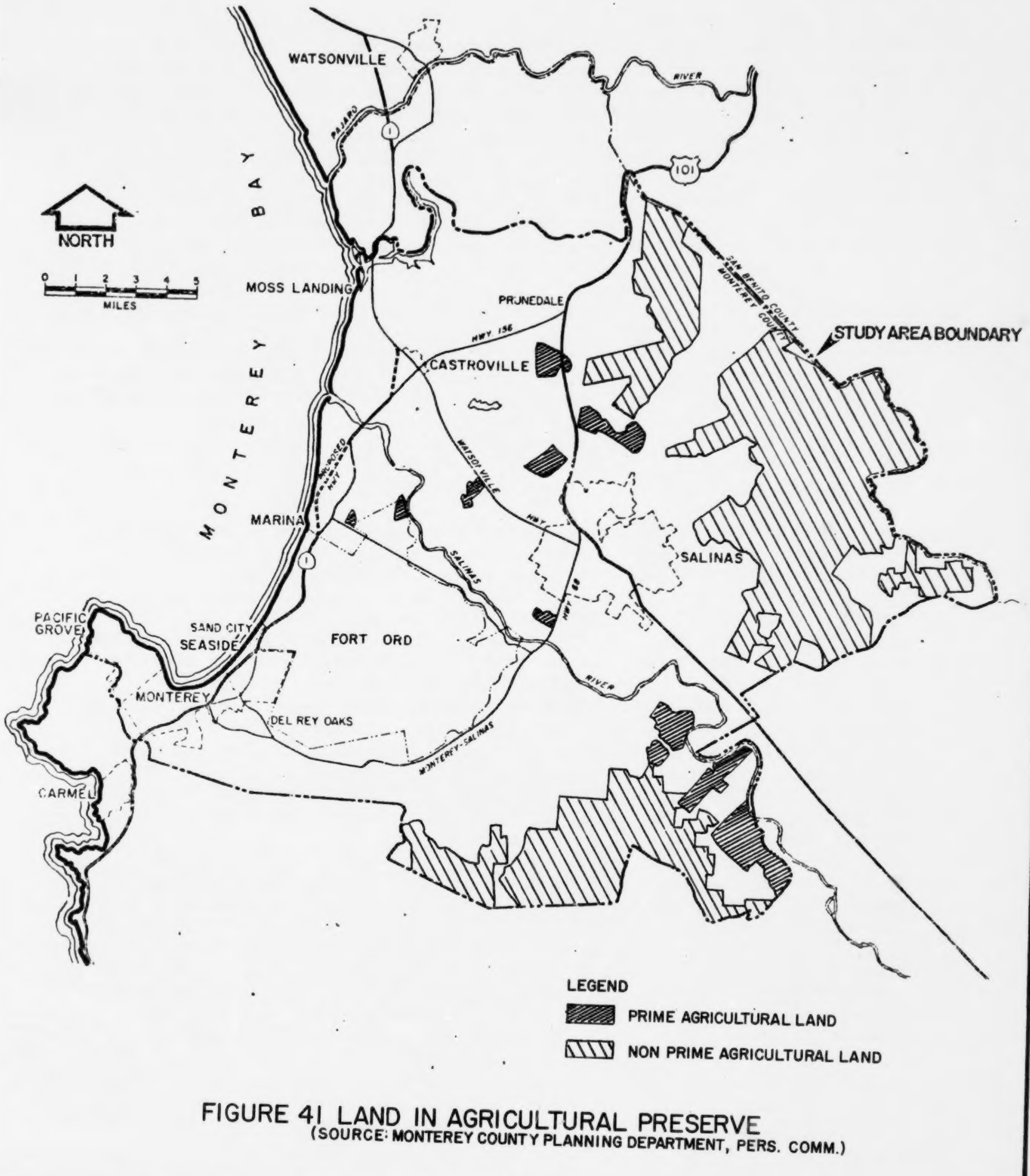


FIGURE 41 LAND IN AGRICULTURAL PRESERVE
(SOURCE: MONTEREY COUNTY PLANNING DEPARTMENT, PERS. COMM.)

A bill proposed in the recent legislative session -- AB 15 -- would have restricted development of Class I and Class II prime agricultural lands. Most of the lands on the Salinas Valley floor would have been affected by the passage of this legislation. Only small patches of prime land exist in other parts of the study area. The effect of a constraint such as that envisioned by AB 15 would be to avoid future absorption of prime agricultural lands by urban uses, thereby, in theory, channeling growth into areas of lesser environmental and economic importance. If market demand is very strong and the amount of land reserved for exclusive agricultural use is large, the effect could be to increase densities in existing built-up areas. It could also be an added impetus to development in rural, outlying potential growth centers where little or no prime agricultural land exists. Prunedale, Monterey II and most of the north county would be included in this category. AB 15 was not enacted, but comparable legislation will very likely be considered in the next legislative session. Until such legislation is passed, the extent to which prime agricultural land will become subject to development pressures will be a function of both local and state regulatory activity and administrative vigilance.

The extent to which land availability would pose a constraint on future development can be evaluated by comparing vacant acreage on the one hand to the acreage requirements of projected new development on the other. These acreage requirements can be roughly estimated based on current residential population densities in the urbanized areas and on population projections for those areas. Population densities on residential land in 1970 have been calculated and are presented in Table 43 for the urban portion of the study area. By dividing these densities into 1995 projected population, the 1995 residential land requirements can be estimated. The implied increase in residential land is then compared to land characterized in 1970 as "vacant" to determine whether the reserve of vacant land is sufficient to absorb increased residential development.

This comparison is admittedly very rough, as it does not take into account the characteristics of the vacant land. It may be that some of these lands are inappropriate for development from a physical, market or regulatory perspective. Neither does this method consider the possibility that future development densities may differ from present ones (although this difference does not appear likely to be extreme). It also does not consider differences in land use classification among jurisdictions; for example, we do not know whether vacant land zoned for residential is classified as "vacant" or as "residential". Within these limitations, however, this approach is useful in pointing to those areas where pressures are most likely to be felt.

The overall population density of the urban areas ranged from 23.9 persons per residential acre in Salinas to 29.1 in the Pacific Grove-Monterey-Seaside urban corridor in 1970. If future development takes place at approximately that density, about 2,500 acres of land in these urban areas would be absorbed by residential development between 1970 and 1995. Total acreage classified vacant in 1970 was about 3,100, or 600 acres in excess of that required.

However, looking at the vacant land supply within the urban subareas indicates that, while the supply in the Monterey Bay urban area appears adequate (407 acres needed vs. 1,643 vacant in 1970) the supply of vacant land in the Salinas urban area appears to be insufficient: over 2,098 acres would be needed for residential use, but only 1,442 acres were classified as vacant in 1970. Salinas is the only city reported by MCTS in 1970 as having agricultural land within its urban limits. It is very likely that some of this agricultural land (1,025 acres within the Salinas urban area in 1970) would be subject to pressure for development over the study period.

Outside of the region's urban centers, development would be taking place on land now vacant. The population growth accounted for within the boundaries of the urban areas in Table 43 is about 62,000, accounting for about 42 percent of the projected growth of about 148,000 (compare Tables 43 and 44) between 1970 and 1995. At an average urban density of 26.6 persons per residential acre, about 3,200 acres of land would be absorbed for residential development outside the Pacific Grove-Monterey-Seaside urban corridor and outside Salinas. Some of this conversion is expected by local planners to take place adjacent to the present community of Marina and some along SR 68 between Monterey and Salinas. Considering the projected population growth in the latter area (1970 population of 5,060 in Planning Areas 36 and 41 vs. 1995 projected population of 40,400) much of the vacant land conversion would be taking place there.

Transportation and Accessibility. Current transportation facilities serving the project area are described in the Environmental Setting. Because investment in transportation improvements can often contribute to changes in the magnitude and distribution of growth, consideration must be given to the likelihood of change in the area's present pattern of transportation facilities. That pattern has remained essentially unaltered over the last two decades. Changes have involved primarily increases in the capacity of existing routes rather than construction of new routes. The capacity of Highway 101 was increased in the late 1950's and early 1960's

TABLE 43

Projected Future Residential Land Absorption in Urban Portions of Project Area, 1970-1995

Area	1970 Residential Land Residential Land, Acres	 Population	 Persons per Residential Acre	1995 Residential Land Population	 Land Requirements, Acres	 Residential Land Absorption, 1970-1995	1970 Vacant Land
Monterey-Seaside Area	2,672	77,777	29.1	89,600	3,079	407	1,643
Salinas	2,463	58,896	23.9	109,000	4,561	2,098	1,442
Urban Total	5,135	136,673	26.6	198,600	7,640	2,505	3,085

1970: Monterey-Seaside area includes Del Rey Oaks (population: 1823; acreage: 120.7 residential and 55.2 vacant), Monterey (population: 26,302; acreage: 1088.2 residential and 1233.7 vacant), Pacific Grove (population: 13,505; acreage: 647.6 residential and 29.4 vacant), Sand City (population: 212; acreage: 7.54 residential and 208.5 vacant), and Seaside (population: 35,935; acreage: 808.1 residential and 116.6 vacant). Salinas = City of Salinas. Population figures from U. S. Census; land use acreage from Monterey County Transportation Study (formerly SMATS), Base Year Report, 1970.

1995: Population figures from MCTS 1974 adjusted to planning areas by Engineering-Science (Table 44). Land requirements = 1995 population ÷ 1970 persons per residential acre. Land absorption, 1970-1995 = 1995 land requirements minus 1970 residential land.

when the roadway was expanded from two to four lanes, contributing to the growth of the City of Salinas (Pugnier, pers. comm.). Upgrading of SR 1 began in the middle 1960's and is still under way. The Carmel-Monterey portion was upgraded to four-lane status between 1966 and 1970. The segment between Monterey and Ft. Ord was upgraded between 1970 and 1972, and at present the roadway is being upgraded to freeway status between Ft. Ord and Castroville. Completion of this project is expected by late 1977 or early 1978. However, there are no present plans to change the existing two-lane configuration of State Route 1 between Castroville and Moss Landing through the planning period ending in 1995 (Case, pers. comm.). For this reason, no overall change in present accessibility to the coastal portion of the region is expected over the study period.

Accessibility to the southern employment centers of the project area -- Ft. Ord, the Monterey Peninsula and Salinas -- by those who live north of Castroville will continue to be limited by the two lane configuration of SR 1 in and north of Castroville. New employees of north county establishments may seek new housing in the Castroville area, but the maintenance of the Moss Landing to Castroville Highway in its present state may encourage development to take place east of Castroville rather than to the north. This possibility would be reinforced by any transportation improvements along the Castroville-Prunedale corridor.

The State Department of Transportation is planning the upgrading of SR 156 between Castroville and Prunedale to a four-lane highway some time between 1985 and 1995. Average daily traffic along that route more than doubled between 1964 and 1974. While no funds have yet been committed for this improvement -- and such a commitment appears unlikely according to Caltrans officials (Thompson, pers. comm.) -- discussion of this project will be a factor encouraging development in this area over the next few decades.

Another improvement to north county accessibility, still only in the talking stage, is the possible establishment of daily passenger rail service along the Santa Cruz-Watsonville-San Jose route. Passenger service on a San Jose-Watsonville-Santa Cruz route formerly was provided by Southern Pacific on weekends, but was discontinued in 1965. Recently, the Counties of Santa Cruz and Santa Clara applied to AMTRAK for establishment of service between the Cities of San Jose and Watsonville. The cost of providing service along the San Jose-Watsonville route is currently being investigated by AMTRAK; the participating counties would be obligated to pay 2/3 of any operating cost deficit of such service (Lloyd, pers. comm.).

Provision of Watsonville-Santa Cruz service would be more difficult. Southern Pacific reports that existing trackage between Watsonville and Santa Cruz is rated for 25 miles per hour and new tracks would have to be constructed along this leg to permit reinstitution of service (Sederholm, pers. comm.).

It is not possible at present to determine whether expanded rail service to northern Monterey County via Watsonville will be provided, nor if so, when. But the impact of this concept should be considered, because it would raise the possibility of establishment of a commuter population in northern Monterey County tributary to Santa Cruz on the one hand and the employment complex of Santa Clara County on the other. Given continuing growth of employment in the San Jose area and the recent efforts of the City of San Jose to slow the pace of residential development, any action which would facilitate the access of Monterey County residents to jobs outside the county could be considered growth-inducing. The fact that the idea of expanded rail service has been raised suggests that the north county area is being recognized as a main growth center within the region over the study period.

With the exception of Highway 156 and the rail service concept, little change in the region's accessibility pattern has reached even the discussion stage. No new roadways are in the works and no changes in capacity are planned for State Route 68 or State Route 218. While there are plans to increase the capacity of U. S. 101 through the project area, these are not expected to be realized until after 1995. Acquisition of property is under way, but has not been completed.

Likely Future Growth

Local Population Projections

Forecasts of future population in the study area have been prepared by individual jurisdictions, and systematically assembled for jurisdictions and traffic zones by the Monterey County Transportation Study (MCTS) and presented in column 1 of Table 44. Inputs to the MCTS forecast were revised and updated by the facilities engineer early in 1976. This forecast is presented in column 2 of Table 44. The 1995 series of local projections, as assembled by the facilities engineer, total 338,300 persons in the study area. This projection represents the most recent population summary currently available. The total is about 16 percent higher than the earlier aggregate 1995 total published by MCTS in 1974, with the bulk of the difference of 46,250

Table 44

POPULATION PROJECTIONS OF TOTAL STUDY AREA COMPARED TO POPULATION ESTIMATED TO BE CONNECTED TO REGIONAL SYSTEM BY 1995

Community	Planning Area	MCTS 1995 Population Projection	Most Recent 1995 Projected by Local Jurisdictions	Approximate Proportion Expected to be Served by Sewer Facilities, Percent	Estimated Sewered Population, 1995
Castroville	32	25,000	23,400	42.7	10,000
Castroville S.D.	33		5,600	100.0	5,600
Marina	34	22,500	19,650	100.0	19,650
Fort Ord	35	30,400	22,500	100.0	22,500
Monterey-Salinas	36	12,600	18,300	100.0	18,300
Salinas South	37	10,990	6,500	2.3	150
San Juan	38		20,800	17.8	3,700
Gabilan	39		2,200	6.9	150
Salinas	40	109,000	107,650	100.0	107,650
Toro	41	12,150	22,100	54.3	12,000
Seaside S.D.	42	29,000	34,550	100.0	34,550
Monterey	43	33,300	33,300	100.0	33,300
Pacific Grove	44	22,100	21,750	100.0	21,750
TOTAL		307,040	338,300	(85.5)	289,300
Column Number:		1	2	3	4

Sources:
Column 1: MCTS, 1974 adjusted to planning areas by Engineering Science, Inc.
Column 2: Calculated from data presented in Columns 3 and 4.
Column 3: Personal communication, William Maddaus, Engineering Science, Inc.
Column 4: Engineering Science, Inc., 1976a; 1995 interpolation by Gruen Gruen + Associates from 1990 and 2000 projections.

attributable to the presently non-urban areas of Monterey-Salinas (up 5,700); Toro (up 9,950) and Salinas South, San Juan and Gabilan (up 18,500). The source of the engineer's estimate for the latter area is the preliminary draft housing element for Monterey County rather than the Planning Department; these figures are subject to future revision by the county.

The total projection of 338,300 represents an increase over the 1970 estimated study area total (191,000) of about 148,000. This represents a compounded annual rate of growth of about 2.3 percent, which is slightly higher than the rate of growth in the 1960's, which was about 2.2 percent per year.

A linear projection of 1960-1970 trends would result in a 1995 population of 280,000; this figure would be attained if the historical incremental increase of about 3,700 persons is maintained in the future. A logarithmic projection, based on a continuation of the past rate of population growth, would yield a 1995 population of 323,000. Although the sum of the most recent projections of the local jurisdictions produces an aggregate projection higher than what extrapolation of existing trends would produce, this does not necessarily mean that the projection of 338,300 persons in 1995 is unrealistic.

Because the projection utilized for facilities planning is the product of work by and consultation with local planning agencies, it reflects whatever assumptions and constraints the planners themselves applied. A long-term continuation of development-limiting regulations (such as the current ban on water connections on the Peninsula) was not among these assumptions. If solutions to the problem of water supply are not found, a lower achieved growth rate will result than that projected. The longer the period of time that restrictive conditions apply, the more likely it becomes that projections based on the conditions which prevailed in earlier periods will be overstated.

Projections by State Department of Finance and State Water Resources Control Board

Population projections for the study's potential service area have been prepared by the State Water Resources Control Board to determine the amount of funds that will be made available to the project. The first step in making these projections is a determination of the potential service area. This has been accomplished by the project engineers. The California Department of Finance then makes an estimate of current population (1975) within that service area. The SWRCB utilizes this existing population estimate and the estimated county growth rates (i.e., D-100, E-0) prepared by the Department of Finance to project future population. Allocation of the expected total county population increase to various portions of the county is done by the SWRCB based on intra-county growth patterns developed by the California Department of Transportation in their report, Projected Socio-Economic Data by County and Statewide Zone (California State Water Resources Control Board, 1976a).

Two series of projections were made by the SWRCB. The first, on which project funding will be calculated, is based on the Department of Finance D-100 population projections for the state and the counties. The second, requested by the Environmental Protection Agency (EPA) for comparative purposes, is based on the Department of Finance E-0 projection. The difference between these two projections, which is about 23,000 persons by 1990 (see Table 45 and Figure 42), derives from the fertility and migration assumptions underlying the projection method.

As both net in-migration and fertility have been declining in recent years, the consideration of the E-0 series appears worthwhile. This series yields lower projections of future population than result from extrapolation of historic trends, and it has been more accurate than other Department of Finance projection series in predicting recent state growth.

Relationship of Wastewater Facilities to Growth

As a major element of urban infrastructure, a wastewater facilities system may be supportive of the urbanization process. In the absence of such a system, growth may be inhibited due to the incapacity of the land itself to support on-site disposal systems. In determining the growth-inducing impact of a specific project, it is useful to consider the extent to which growth would take place in the absence of the project and the effect a project would have on the form and spatial distribution of growth.

There are four major types of development conditions in the MPWPCA planning area: 1) infill of vacant parcels in the long-established areas of such older communities as Salinas and Monterey, 2) suburban subdivision development contiguous to existing urban areas, 3) custom homes on individual lots, and 4) major new town-type developments. Some of the anticipated future development would be tied into a regional wastewater facilities system of the type described in this report as a matter of course. Some future development might not be served by a regional system. The relationship between development type and a regional wastewater facilities system is discussed below by type of development.

Table 45

SERVICE AREA POPULATION PROJECTIONS

	Planning Areas	SWRCB 1990 Projections		Facilities Plan[3]		
		E-0	D-100	1990	2000	Ultimate
Castroville	32,33	8,820	9,790	12,800	18,400	22,900
Marina	34	14,110	15,465	17,300	22,000	22,000
Fort Ord	35	omitted[2]	omitted[2]	{ 20,000	25,000	25,000}[1]
Salinas	37-40	92,335	102,860	105,300	118,000	207,200
Toro	41	3,645	4,055	9,000	15,000	15,000
Monterey Peninsula	36, 42-44	84,890	94,435	99,200	116,600	122,000
Subtotal		203,800	226,605	243,600	290,000	389,100
Moss Landing	--	710	825	NA	NA	NA
TOTAL (WITHOUT FORT ORD)		204,510	227,430	243,600	290,000	389,100
TOTAL (WITH FORT ORD)		---[2]	---[2]	263,600	315,000	414,100
Column Numbers	1	2	3	4	5	6

[1] Fort Ord figures excluded from first total for comparative purposes.

[2] Fort Ord projections excluded from state figures because flows from major activities of the federal government are not grant-eligible.

[3] Facilities Plan assumes entire service area population will be connected to regional system, therefore service area and anticipated sewered populations are the same.

NA Not applicable.

Sources: Columns 2 and 3 from State Water Resources Control Board, 1976a, adjusted to 1990 by Gruen Gruen + Associates; Columns 4, 5 and 6 from Engineering Science, Inc., 1976a.

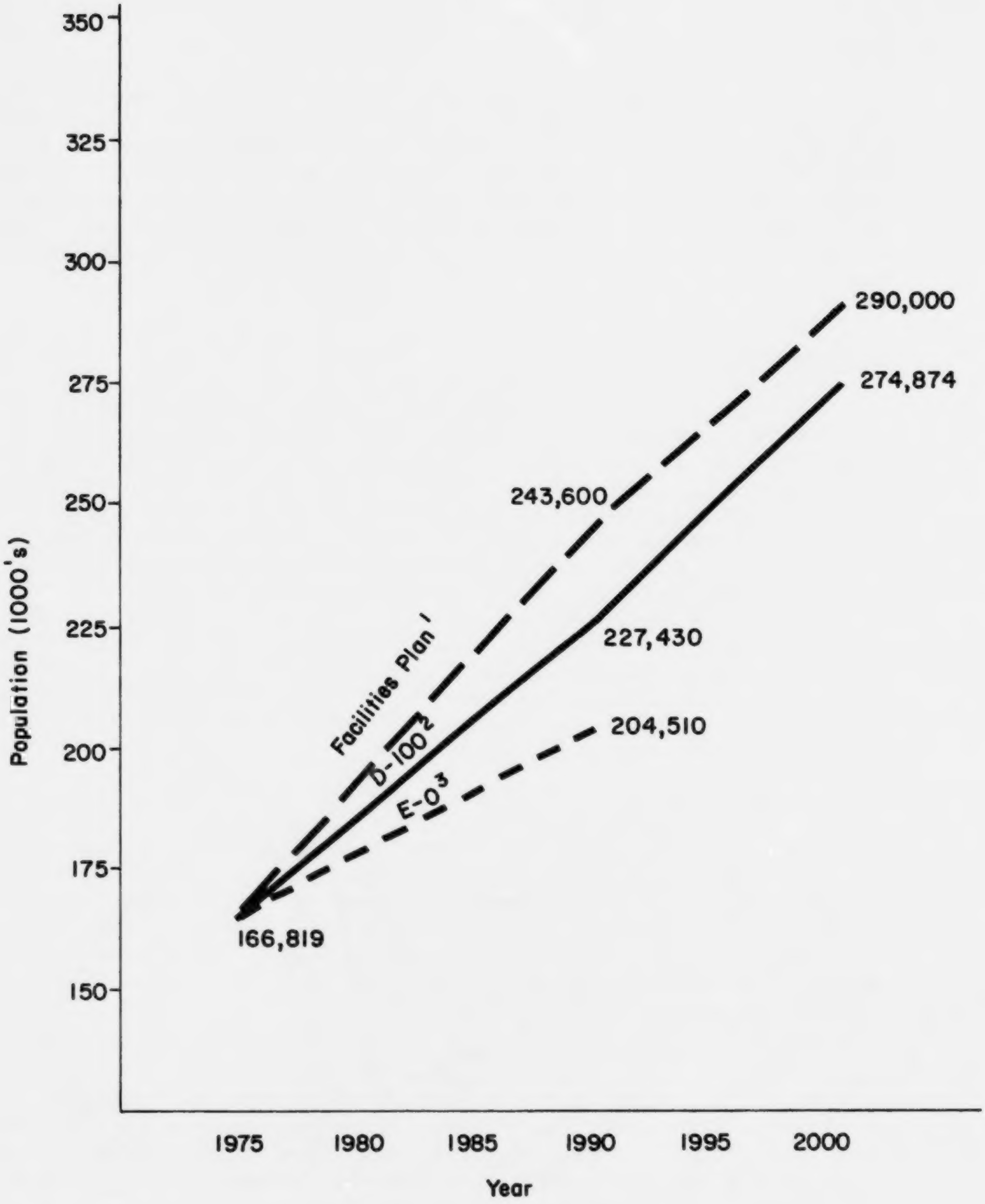


FIGURE 42 SERVICE AREA POPULATION PROJECTIONS

[1] Anticipated sewered population used to size project facilities (Ford Ord subtracted from the Facilities Plan projection to make it comparable with SWRCB projections). Facilities Plan assumes 100 percent sewering of service area population.

[2] SWRCB's maximum fundable population projection for service area.

[3] E-0 projections are used for determining maximum fundable population in an air quality maintenance area.

Infill

Increases in existing densities in cities such as Seaside and Monterey are expected as remaining vacant parcels are developed; occasionally, older single-family units on larger lots are replaced by multi-family units. Increases of this type, which tend to be scattered throughout an area, can typically be absorbed by the existing wastewater system. Regionalization and expansion of the present system would have minimal impact on this type of development.

Suburban Subdivisions

A typical form of urbanization, in northern Monterey County as elsewhere, has been subdividing and residential construction at the urban fringe. This type of development typically utilizes excess capacity in one or more of the existing public service systems so that new housing costs need not immediately reflect total infrastructure costs. The developer's desire to tie into existing infrastructure is one factor discouraging premature development of parcels not contiguous to existing development. "Sprawl" in the form of discontinous development patterns (also called "leapfrogging") may still take place if local development practices and procedures permit it, but it often is a temporary phenomenon, as intermediate vacant land leaped over becomes susceptible to increased pressure for conversion.

Subdivisions at the urban fringe would typically be required to supply the full range of urban services, including wastewater collection and off-site treatment and disposal. In fact, development may not be permitted if excess capacity in one or more service systems is lacking. A shortage of treatment or disposal capacity could, therefore, prove an impediment to this type of new development, while construction of expanded wastewater facilities would accommodate this type of growth.

Low Density Development. The General Plan for the north county area (including the Castroville-Prunedale corridor) which was adopted in 1964 indicated an overall density of four acres per dwelling unit. However, zoning in the area has historically been one/half acre per unit. Development patterns have reflected this inconsistency. Recent changes in zoning are aimed at reversing this trend. Zoning is now about 3.6 acres per parcel, more in line with the General Plan (Bakeman, pers. comm.). This zoning is also designed at least in part to avoid septic tank failure problems. The County Environmental Health Department has taken the position that lots must be at least one acre in size to support a septic tank. Therefore, it appears that low density development could continue in this area without being tied into a sewer system. A similar situation exists in the Monterey-Salinas corridor. Soil conditions and zoning are such that development on lots larger than one acre could continue without a sewer system. Septic tank suitability is evaluated on a lot-by-lot basis, however, as localized soil and slope conditions must be analyzed.

The denser rural developments such as Oak Hills (half-acre lots) and Las Lomas (quarter- and half-acre lots) could reasonably be served by a regional wastewater system. The County Environmental Health Department supports this contention, and in addition suggests that the denser developments in the Monterey II and the Toro-San Benancio-Corral de Tierra areas eventually be served by larger sewage disposal systems (Wong, pers. comm.).

Current zoning north of Marina and north of Salinas would also permit low density development; most zoning stipulates 2.5-acre minimum lot sizes. The feasibility of using septic tanks in these areas must be determined by on-site percolation tests and soil borings; the general soil conditions indicate most large lots could support a septic tank north of Salinas. However, the sandy soils north of Marina have severe limitations for septic tank use, according to the county soil survey (U. S. Soil Conservation Service, 1975). The rapid soil permeability could lead to contamination of groundwater.

In the last decade, low density development in the north county has accelerated, a trend which may have been accentuated by the water connection ban on the Monterey Peninsula. This is the fastest growing area of the county at present, but even at low levels of density, sufficient land exists to absorb roughly 25-30 years of growth (Bakeman, pers. comm.).

Major "New Town" Type Subdivisions

County practice is to require large developments to provide a sewerage system (Bakeman, pers. comm.). The size of major developments makes this approach financially feasible to a project developer as the cost can be spread over a large volume of housing units. Developing and operating a small community or subdivision-sized treatment plant is subject to granting of a permit by the Regional Water Quality Control Board. The RWQCB notes the possibility of problems with package plants or small systems, which include: 1) locating an acceptable disposal site; and 2) achieving a consistently acceptable record of operation and maintenance (small system maintenance is generally poor).

These reservations on the part of the RWQCB may result in the formulation of official policy on the small community systems issue. RWQCB is drafting a resolution to amend the SWRCB's Central Coastal Basin Plan to address this issue. In the meantime, opposition to the proliferation of small community systems by the RWQCB could take the form of denying a discharge permit or imposing extremely restrictive standards on discharges (Baldridge, pers. comm.).

The RWQCB cannot and has not issued a blanket prohibition of small treatment systems. Proposals are reviewed individually at the time permit application is made. Staff reports that the RWQCB would oppose the use of small systems to support continued growth in rural areas such as the Monterey-Salinas corridor and the Castroville-Prunedale corridor -- the areas in which this type of development would be expected to take place (Baldridge, pers. comm.).

The regulatory response to a developer permit application is difficult to forecast. Certainly a developer who puts in a sewer system with a package plant has not necessarily foreclosed the option of having the community system connect to the regional system at some future time, and from that perspective capacity in a regional treatment plant provided in anticipation of this contingency can be considered growth-accommodating. Should the RWQCB make it mandatory that new town scale subdivisions be connected to a regional system from the beginning, then the provision of such a system would facilitate this type of growth, assuming that the connection can be made. If the regional connection is stipulated as a precondition to development, but proves impossible to achieve, then the type of highly concentrated development envisioned for such areas as Montera and Laguna Seca could not be realized, and the spatial distribution of growth would shift from a pattern of fairly dense residential areas encompassed by open space to a large-lot, low density type of development of the type already taking place in the Prunedale area. Such low density development may result in fewer water quality problems, assuming on-site disposal is acceptable; however, it also may effectively foreclose future urban service options (such as transit service) and may result in higher off-site development costs, especially for roads.

Accommodation of Future Growth

The wastewater facilities plan described in this report would accommodate future growth in the region. Two of the four types of development discussed above -- in-fill and fringe subdivisions -- would be connected to such a system initially. A third, the "new town"-type development, might be connected initially, depending on whether such a connection is made mandatory by the RWQCB or local planning agencies. Even if not connected initially, it appears likely that connection would eventually be implemented (assuming that the Highway 68 area developments retain the concentrated form which has been proposed).

Low density development such as that anticipated in the Prunedale area would not initially be served by a regional system and the dispersed nature of this development would make provision of sewerage at any future time very costly. In case development along SR 68 between Monterey and Salinas takes shape as low density, that growth too would not be served by a regional system. The assumptions of the facilities engineer with regard to these two areas are: 1) only the relatively high density existing development along SR 156 between Castroville and Prunedale would be tied to the regional system; and 2) the developments along SR 68 will be in a concentrated pattern and will be connected to the regional system.

The fact that all but low density growth could if necessary be served under the proposed facilities plan does not mean that equivalent growth would not take place in the absence of the plan. The recent experience of a ban on new water connections on the peninsula has shown that growth pressures can be displaced from one area (in this case, the relatively dense urban corridor including Carmel and Monterey) to other areas (the relatively dispersed, low density development in the rural north county). While capital facilities such as wastewater systems accommodate growth, the lack of such facilities encourages low density development which would become the future pattern in rural Monterey County under present planning and zoning conditions.

Strong pressure for development in Monterey County will continue to be felt. Availability of wastewater facilities is one of several factors influencing the location and type of growth to be realized. Water supply, the road network and increasingly effective means of assuring the preservation of prime agricultural lands are other factors at least co-equal in shaping northern Monterey County's urban form in the future.

The facilities plan would provide treatment plant capacity for the anticipated 1990 population growth in sewered areas. It would also provide capacity in the regional interceptor for sewered area population growth to the year 2000. In two of the sewered areas -- Marina and Toro -- it is anticipated that the year 2000 growth to be served by the regional system will be the ultimate population of the sewered area. In three sewered areas, "ultimate" population exceeds the anticipated year 2000 population. These differences are presented in Table 45. They affect Castroville, Salinas and the Monterey Peninsula (Pacific Grove, Monterey, Seaside and the Monterey-Salinas Highway area). In the Castroville area, the ultimate exceeds the year 2000 population by 24 percent; in Salinas, by 76 percent; on the peninsula, by 5 percent. Of these three cases, the facilities engineer has proposed to allow capacity in the regional interceptor only for the Monterey Peninsula ultimate population, where the difference between ultimate and year 2000 population is slight.

Environmental Impacts of Growth

The growth which the region will experience in the future will have associated with it a number of secondary impacts on the natural and human environment. As land is developed, its availability for other use is foreclosed and its encumbrance with structures housing human activities implies a series of on-site and off-site effects. These would involve all of the types of facilities which are required to support human activity and all of the effects which expanded population and activity have on the natural environment. Major areas of possible secondary impacts are as follows.

Land Use

The most visible sign of population growth is the gradual loss of open land. This, in turn, may have impacts on aesthetics and wildlife (discussed below) and it may, depending on the pattern of development which emerges, result in a loss of economic benefits as well if the urbanized acreage is taken out of active agricultural production.

As discussed earlier in this chapter, conversion of vacant land to urban use could affect as much as 6,000 acres by the year 1995 if population growth takes place at present population densities. However, present urban densities in the Monterey-Seaside area and Salinas are well in excess of even the highest density development now permitted by the county. As Table 43 shows, current average urban densities are 26.6 persons per residential acre. At a household size of 2.75, that would amount to approximately 10 housing units to an acre, or five times the density of a half-acre-per-unit development.

As larger developments are proposed, densities higher than one-half acre of residential land per unit appear likely. Since large developments must provide urban services, residential concentration is in the interest of the developer. Both annexations and large developments in unincorporated areas will be affected by this consideration. In the case of annexations, which applies to the SR 68 corridor (to be annexed to the City of Monterey) and to the presently rural areas north and northeast of Salinas (where annexation to Salinas appears likely), current procedures are for the city to which the development is to be annexed to work with the developer, thereby assuring that the development will be consistent with the city comprehensive plan in terms of density and development form.

In the unincorporated county, various subarea plans indicate objectives of retaining agricultural uses. For example, the Castroville and Moss Landing area plans both state that future growth should not encroach on prime agricultural lands. The plans also advocate the protection of wildlife habitat along the sloughs and coastline. Implementation of these policies with regard to development proposals takes place on a case-by-case basis and may occasionally go further than these concerns (Bakeman, pers. comm.) to include stipulations with regard to specific features (such as groves of trees).

Both city and county development review procedures take note of proposed densities and potential environmental conflicts. If the planning agencies promote higher densities by putting the same number of housing units on a smaller land area (thereby leaving more land in open space), then conflicts with agricultural land and environmentally sensitive areas will be lessened. However, there may be resistance to this approach by those who find the visual impacts of denser settlement patterns adverse. Where sparse development permits, responsibility for water supply and wastewater disposal can be borne by the homeowner; avoidance of municipal responsibility for these functions can be another factor in encouraging new development to take place at low densities. These factors may also be considered in the development review process.

Although no prime agricultural land preservation legislation is yet in effect, it appears likely that such a law will be passed, probably within the next three years, thereby adding to municipal and county efforts in this area the weight of state law. In the meantime, with the possible exception of lands lying within the city limits of Salinas, vacant land conversion in the project area is likely to affect lands of only marginal agricultural value.

Public Services and Utilities

Every new housing unit brings with it new revenue and added costs to government(s) within the jurisdiction(s) in which it is located. Revenues include both direct payments in the form of property taxes, calculated on the basis of the value of the housing unit and the government agency tax rate, and indirect payments such as sales taxes and motor vehicle taxes, which are collected by the state and returned in part to the local jurisdiction. The cost is made up of the individual costs of public agencies in responding to the added household's demand for public services.

The fiscal impact of a new housing unit depends on a variety of factors. Important among these is the assessed valuation of the land and building, which is the basis of property taxation. Also important is the type of household. If there are school-age children, then educational costs will be incurred; childless households pay school taxes even though they have no children in the local school system.

Fiscal impacts of the same housing unit may also differ among the government agencies in whose jurisdiction the home is located. This variation arises from differences in ability of the governments or districts to extend service to the new unit without incurring additional capital or operating costs. From this point of view, a household with school-age children could settle in the Monterey Unified School District area, which has excess capacity in its physical plant, imposing a lower cost on that district than it would impose on one of the north county districts with expanding enrollment, for which new facilities will eventually be constructed.

These three factors -- differences among new residential units in amount of revenue generated, differences among new households in type and amount of costs imposed, and differences among government agencies in the extent of their excess capacity -- are the major considerations which make it impossible to generalize about the relationship of growth to a region's fiscal status. This work can be done with a fair degree of accuracy for specific new developments or for new towns (where the entire infrastructure is new); for a region as large and varied as northern Monterey County, it is impractical. However, by considering the magnitude of growth anticipated -- 148,000 between 1970 and 1995 -- it is clear that no public service has sufficient excess capacity to extend service to all of the added population. This means that expansion of public service systems can be expected, with the costs paid for by present and new residents.

Water Supply

As mentioned in the Environmental Setting section, much of the study area is currently suffering from domestic and agricultural water supply problems. The Monterey Peninsula is operating under a building ban due to insufficient water supply. Groundwater supplies in the lower Salinas Valley are deteriorating in quality due to overdrafting and resultant salt water intrusion. The direct impact of the various proposed regional wastewater systems on water supply was described in an earlier section of this report. Several alternatives could increase the local water supply by reusing treated domestic wastewater for crop irrigation. The secondary impact of a new wastewater system on the local water supply is not as easily defined, however.

The proposed project would supply wastewater treatment facilities for a population in excess of current numbers. The 1975 project service area population is estimated at 166,819 (191,113 with Ft. Ord; California State Water Resources Control Board, 1976a). The 1990 design capacity of the regional wastewater treatment plant is based on a service area population of 283,600 (Engineering Science, Inc., 1976a); the interceptor system is sized to accommodate flows from a future service area population of 320,400. As mentioned above, the sewer facilities would not necessarily cause or induce this growth; other services and facilities would be needed. In many instances, the growth could occur without the wastewater facilities. However, if sewer facilities are installed and other basic services are provided so that populations increase, in the absence of additional water supplies, there would be even more serious overdrafting of existing local water supplies. Because of the building ban on the peninsula, growth would likely occur to a greater degree in the Salinas and Castroville areas and the north county. Growth in Salinas and Castroville would intensify the overdrafting of the 180- and 400-foot aquifers in the Salinas River basin and increase the salt water intrusion problem in the Castroville area.

Even in the absence of new regional wastewater capacity, there is likely to be continued and increased pressure for development of new water sources in the area. In order to accommodate the populations projected in the Facilities Plan, local sources must be better utilized; water conservation strategies must be developed, implemented and enforced, or outside sources must be tapped. There are several other sources currently being investigated. The wastewater to be treated by this project is one potential source. Tapping of deeper aquifers in the Salinas Valley, increased surface releases from Nacimiento and San Antonio Reservoirs, and enlarged and new dams on the Carmel River are also being investigated as new sources of water.

Water conservation measures applied by individual and industrial users and reuse of the treated wastewater appear to be extremely advantageous methods of relieving the regional water shortage situation. There are potential adverse environmental consequences of reusing wastewater for irrigation, but these could be investigated by the planned pilot project prior to full implementation. Specific water conservation programs already in effect are described in the Public Services and Facilities section of the Environmental Setting. Similar efforts could be advanced by other cities and the county, including changes in the building codes to encourage use of more efficient water fixtures and appliances. City councils, the Board of Supervisors and departments of public works could all have a hand in implementing conservation measures. An effort at public education could be made through local school districts and the water suppliers themselves.

Increased storage and surface releases from Salinas River watershed reservoirs have limited potential; this water is already being utilized at near its full potential. Additional upstream diversions would only reduce the amount of water now percolating to the groundwater table, which acts as the major water supply for Salinas Valley communities. The reliability and general quality of water from deeper aquifers in the Salinas Valley is now being investigated. There are questions, however, on the effect deep aquifer pumping will have on the 180- and 400-foot aquifers which currently supply water to Salinas Valley residents. New dams on the Carmel River present a whole list of economic and environmental concerns. The cost of a new dam would be great (over $100 million) and the effects on downstream fisheries, vegetation and groundwater supplies could be significantly adverse. Reduction in downstream flows, especially in the dry months, could destroy riparian vegetation, eliminate fish habitat and drop groundwater levels in areas being actively pumped for domestic water supply. Numerous sites and sizes for reservoirs have been contemplated on the river, but no project is being actively pursued at present.

The most extreme method of reducing secondary impacts on water supply (associated with regional growth) through the facilities planning process would be to limit wastewater treatment capacity to the existing population. Limiting the provision of public services is being used more and more frequently as an indirect method of limiting growth, as is prohibition of growth generators like new employment sources and second home subdivisions. Limiting growth is not necessarily the best method of solving the water supply problem, however. Wiser use of existing supplies, active water conservation programs and beneficial reuse of wastewater wherever possible are more positive mitigations for increased water demands.

Water Quality

The conversion of land to industrial, commercial and residential uses that accompanies growth can increase water quality problems as well as problems with water supply. The two most obvious areas of concern are increased urban runoff and soil erosion. As agricultural or undeveloped land is covered over by buildings and pavement, the amount of precipitation that runs off as overland flow increases. Oil and grease and the wide variety of chemicals that are used around dwellings are carried in greater quantities into storm drains and surface waters. Where soils have been disturbed during construction, the heavier runoff carries with it soil material; this affects both the quality of surface waters and their value as wildlife habitat. Most urban runoff enters storm drains or natural drainageways; it therefore passes untreated into the surface and groundwaters.

Control of urban runoff and erosion has received little attention in the past. This is mainly because neither has contributed to the wastewater treatment problems of local agencies. However, PL 92-500 requires development of plans to control these non-point sources of pollution. The 208 planning in north Monterey County is being conducted by AMBAG. Their work plan included an analysis of non-point sources of pollution in the lower Salinas Valley, including increased urban runoff from Salinas. Impacts are to be identified and mitigations suggested. This 208 Plan appears to be the proper vehicle for adding detail to this brief analysis of growth-related water quality problems. Especially important will be the assignment of responsibility for reducing urban runoff and erosion problems. Erosion can be controlled to a great extent by proper building inspection and regulation of development on steep slopes or highly erosive soils by the county building inspector and planning department. Avoiding disturbance of steep slopes and replanting denuded areas are effective erosion control measures. Urban runoff is more difficult to control. Limitations on the percent coverage structures may have on residential or commercial lots could help. A more effective but more costly measure would be to channel storm drain water through a wastewater treatment system. This would have to be implemented by public works departments or sanitation districts and is unlikely to occur in the near future because of the high cost involved.

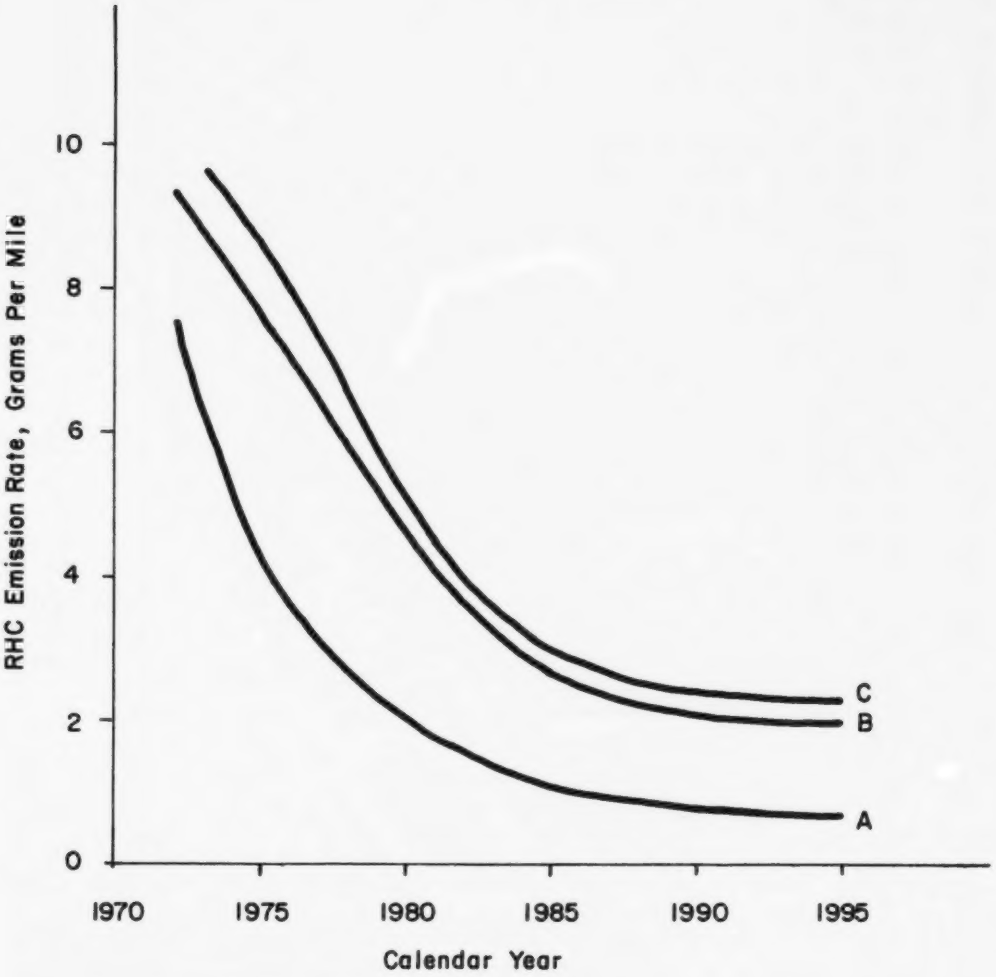
Air Quality

Introduction. Wastewater treatment facilities are an essential requirement for modern urban areas. Their availability is one of several factors influencing the type, amount and location of future urban development. Future development accommodated by the proposed project will influence air quality conditions in Monterey County through the presence of increased vehicle traffic and the development of new stationary sources of air pollutants.

During the preparation of this EIS, the air quality implications of the proposed project have been examined in detail on three separate occasions. The results of the first evaluation, completed in February 1976, are presented in Appendix A-5. Revisions to the technical data used in that air quality analysis and changes in the design basis for the proposed project necessitated the additional air quality evaluations. These considerations are discussed in detail in Appendix A-7. The significance of some of these factors is reflected in Figure 43 and Table 46. Figure 43 illustrates the recent revisions which federal and state agencies have made to their estimates of reactive hydrocarbon emission rates from the vehicle population expected to be operating in Monterey County. Table 46 compares the Department of Finance D-100 population projections with the population projections currently being used as a design basis for the proposed project. When Appendix A-5 was originally prepared, project sizing was based on a population projection prepared for the Monterey County Transportation Study. This population forecast (407,000 for the county in 1995) was only slightly larger than the Department of Finance D-100 projection of 396,500, which served as a basis for the air quality evaluation presented in Appendix A-5.

The major concern regarding future air quality in Monterey County centers on oxidant levels. Thus, all revisions to the air quality analysis presented in Appendix A-5 focused on hydrocarbon and nitrogen oxide emissions and subsequent oxidant and NO_2 levels.

Emissions Forecasts. At the time the present air quality analysis was prepared (February 1977), two sets of historical emission inventory data were available -- data from the local air pollution control district and data from the California Air Resources Board. The ARB estimates for 1973 differ from the APCD estimates in several respects (see Appendix A-3). The discrepancies regarding stationary source emissions were resolved through discussions with the staff of the ARB Emissions Inventory Unit. Discrepancies in motor vehicle emission estimates related



A = Values used in February 1976 analysis
B = Values used in November 1976 analysis
C = Values used in February 1977 analysis

FIGURE 43 TRENDS IN COMPOSITE VEHICLE REACTIVE HYDROCARBON EMISSION RATES

Table 46

COMPARISON OF SERVICE AREA AND COUNTY POPULATION PROJECTIONS

Year	Facilities Plan Projections[1]		California Department of Finance D-100 Projection		County Composite Projection[4]
	Sewered Population	Total Service Area Population	Service Area[2]	County[3]	
1972				253,300	
1973				255,400	
1974				261,600	
1975			166,819	271,600	
1979			181,825	(293,307)	
1980	204,800	214,233	[185,354]	299,000	327,879
1985		(229,981)	[206,645]	329,800	363,136
1989			222,683	(355,396)	
1990	263,600	268,824	[226,884]	362,100	404,040
1995	289,300	338,300	[249,461]	396,500	485,339
1998			265,392	(421,821)	
2000	315,000	371,540	[269,531]	428,400	530,409

NOTES AND SOURCES:

[1] Derived from Table III-6 in Engineering Science, Inc., 1976d; value for 1985 interpolated using logarithmic growth rate ($N_t = N_o e^{rt}$); values for 1995 from Table 44 of this report.

[2] California State Water Resources Control Board (pers. comm.).; values in brackets calculated from ratios of service area population to county population for previous or subsequent entries.

[3] California Department of Finance, 1974; values in parentheses interpolated using logarithmic growth rates.

[4] Facilities plan projections for service area plus D-100 projection for remaining portions of the county. (County D-100 population - service area D-100 population + service area facilities plan population.)

to two factors: use of different vehicle emission factors; and apparently significant differences in estimates of historical VMT levels. To maintain consistency between base year and forecast year emission estimates, neither the APCD nor the ARB vehicle emission estimates were used. Instead, two different sets of historic and projected VMT levels were used to generate alternative base year and forecast year motor vehicle emission estimates.

Emissions forecasts for 5-year intervals from 1980 through 1995 were prepared assuming two different levels of urban development (based on the Department of Finance D-100 and the "county composite" population projections presented in Table 46). The basis for estimating future emissions from stationary and mobile sources is explained in Appendix A-7. Two estimates of motor vehicle emissions were made for each population projection in order to cover a range of possible vehicle usage estimates. The MCTS-derived data involve a 1973 daily travel level of 19.5 VMT per capita. This is projected to increase to 20.3 VMT per capita by 1995. The alternative VMT analysis (designated ARB-DMV) involves a 1973 daily travel level of 13.6 VMT per capita. This is projected to increase to 15.0 VMT per capita by 1995. Thus, the MCTS-based forecasts assume a 14.4 percent increase per capita VMT between 1973 and 1995 while the ARB-DMV-based forecasts assume a 10.7 percent increase.

Techniques for Evaluating Future Ambient Air Quality. A large number of different procedures have been developed for estimating ambient air quality changes under specified conditions. Many of these procedures are appropriate only for certain types of projects (highways; parking lots; major point sources such as power plants, etc.). When the impact of generalized urban development is the primary concern, available procedures can generally be classified into two categories: "mechanistic" simulation models of variable complexity; and simple statistical extrapolations from historical data.

The major appeal of complex simulation models lies in the fact that they can be structured to explicitly deal with the numerous factors which are known to affect ambient air quality. In general, a usable simulation model should deal with the following factors:

- Spatial and temporal distribution of emission sources.
- Meteorological and topographic factors influencing pollutant transport.
- Meteorology and atmospheric chemistry affecting the residency of primary pollutants (directly emitted pollutants) and the formation of secondary pollutants (generated from primary pollutants by chemical reactions in the atmosphere).

This potential for dealing with the "real world" complexities of the various processes which affect air quality is also the basic reason such models are seldom used. As such models are made more complex to reflect actual physical and chemical processes occurring in the atmosphere, the requirements for detailed, geographically specific base data increase substantially. Most of this required data is not readily available and must be developed through special and/or long-term studies. In addition, as these models become more complex, it becomes necessary to use advanced computer technology to perform the required calculations. The results of such models, no matter how complex, can be no more accurate than the base data and mathematical equations used in the model to describe physical and chemical processes occurring in the atmosphere.

The rollback procedure, on the other hand, avoids any attempt to deal explicitly with the complexities discussed above. Changes in ambient air quality are assumed to be proportional to changes in total emissions of the pollutant of concern (or the precursor emission products for secondary pollutants). Natural background levels of pollutants can be considered as a special factor if data is available. In addition, the basic rollback equation (see notes to Tables 47 or 48) can be modified to account for influx of pollutants from outside the study area if data on this is available, although this is seldom done.

While simulation models are often designed to forecast a geographic distribution of pollutant levels, the rollback technique produces a single value for future air quality. Depending on the base data used in the rollback analysis, this may represent a potential "worst case" situation, average hourly pollutant level, etc.

The following simplifying assumptions inherent in the rollback approach must be recognized when determining how to use this procedure or how to interpret its results. Pollutant emissions are assumed to be constant through time and geographically uniform. Transport of pollutants into or out of the study area is normally assumed to be negligible. Meteorological factors are not directly considered; implicitly, the rollback technique assumes that meteorological conditions in a future year are essentially identical to the base year used. Finally, chemical reactions among pollutants are not considered. Some of these limitations are counter-balanced by using the highest reported pollution levels as base values in the model; such a procedure implicitly assumes that this represents a combination of unfavorable conditions.

It should also be apparent that the rollback procedure is most appropriately used to evaluate the air quality implications of a given overall amount of development. It is not, however, well suited to comparing the air quality implications of alternative spatial distributions of land use or alternative time distributions of pollutant-generating activity patterns.

Interpretation of the results of any air quality analysis should recognize that all forecasting procedures and models are best utilized for estimating air pollution potential rather than making air quality projections (in the same sense that population projections are made). On a year-to-year basis, air quality is usually determined primarily by weather patterns and conditions. The ability to predict future ambient air quality conditions is limited by numerous considerations, not the least of which is the inability to confidently predict future weather conditions in any detail. Thus, even the most sophisticated computer models which may be developed in the foreseeable future will be unable to predict ambient air quality conditions for specific dates in the future. Current and anticipated air quality models are more properly utilized to predict the potential for meeting or exceeding established air quality standards based on pollutant emission forecasts for given future years. Rollback techniques approach this issue through the use of "base year" data reflecting serious pollution episodes experienced in the recent past. A "worst case" analysis can be approximated by using the year showing the highest ratio of observed peak ambient pollution level to estimated daily emissions of the appropriate pollutant.

Potential Oxidant and NO_2 Levels in Monterey County. The analysis of potential oxidant and NO_2 pollution in Monterey County was performed using the simple rollback procedure discussed above. Table 47 presents a series of alternative forecasts of potential maximum 1-hour oxidant levels in Monterey County. Two population forecasts (D-100 and "county composite") were combined with two different sets of VMT assumptions (MCTS and ARB-DMV) to produce four basic population/VMT alternatives. The differences in total VMT levels between the MCTS and ARB-DMV forecasts are shown in Table IV of Appendix A-7. The differences in underlying daily per capita vehicle travel rates were identified above. Aircraft, railroad, stationary and miscellaneous area source reactive hydrocarbon emission levels are related to population growth assumptions (Tables VII and VIII in Appendix A-7). Motor vehicle reactive hydrocarbon emissions are based on VMT levels and weighted, class-composite vehicle emission factors (Tables IV and V of Appendix A-7).

Table 47

INFLUENCE OF ALTERNATIVE VMT ESTIMATES AND BACKGROUND OXIDANT ASSUMPTIONS ON PROJECTED MAX-HOUR OXIDANT POTENTIAL FOR MONTEREY COUNTY

VMT Forecast	Population Basis	Parameter	1974	1980	1985	1990	1995
Adjusted MCTS Data	D-100 Projection	Vehicle RHC	52.0	34.1	23.1	20.9	21.9
		Total RHC	71.5	57.4	49.8	50.6	54.4
		OX @ B = 0	0.112	0.090	0.078	0.079	0.085
		OX @ B = 0.005	0.112	0.091	0.080	0.081	0.086
		OX @ B = 0.01	0.112	0.092	0.081	0.082	0.088
Adjusted MCTS Data	County Composite Projection	Vehicle RHC	52.0	37.7	25.4	23.2	26.8
		Total RHC	71.5	63.2	54.3	56.8	63.3
		OX @ B = 0	0.112	0.099	0.085	0.089	0.099
		OX @ B = 0.005	0.112	0.100	0.086	0.090	0.100
		OX @ B = 0.01	0.112	0.100	0.087	0.091	0.100
ARB-DMV Data	D-100 Projection	Vehicle RHC	36.2	23.5	15.9	14.2	14.8
		Total RHC	55.7	46.8	42.6	43.9	47.3
		OX @ B = 0	0.112	0.094	0.086	0.088	0.095
		OX @ B = 0.005	0.112	0.095	0.087	0.089	0.096
		OX @ B = 0.01	0.112	0.096	0.088	0.090	0.097
Adjusted ARB-DMV Data	County Composite Projection	Vehicle RHC	36.2	25.8	17.3	15.7	18.1
		Total RHC	55.7	51.3	46.2	49.3	54.6
		OX @ B = 0	0.112	0.103	0.093	0.099	0.110
		OX @ B = 0.005	0.112	0.104	0.094	0.100	0.110
		OX @ B - 0.01	0.112	0.104	0.095	0.100	0.110

NOTES AND SOURCES:

Alternative VMT and population projections presented in Table IV of Appendix A-7.

RHC = Reactive Hydrocarbons. Motor vehicle and total RHC emissions given as tons per day, annual average (values taken directly from or calculated using Tables III through VIII of Appendix A-7).

OX = Ambient oxidant level in parts per million (ppm) by volume; 1974 oxidant level from Appendix A-4, corrected by 0.8 factor to account for recent change in calibration procedures for monitoring instruments (see Appendix A-2).

Federal 1-hour primary ambient air quality standard for oxidant = 0.08 ppm.

California 1-hour ambient air quality standard for oxidant - 0.10 ppm.

B = Natural background oxidant level in ppm.

Projected Max-Hour oxidant potential based on unmodified "rollback" technique:

$$AQ_{fy} = B + (AQ_{by} - B) \times \frac{E_{fy}}{E_{by}}$$

Where: AQ = Ambient air quality (ppm)
B = Natural background pollutant level (ppm)
E = Emissions of precursor pollutant; RHC emissions, tons per day
by = Base year; 1974
fy = Forecast year

In addition, the influence of different assumptions regarding natural background oxidant levels was evaluated. While natural background levels of ozone and other oxidants do exist, no estimates of such levels for the Monterey Bay area have been made. Within the range of values tested, choice of background level had only a minor influence on projected potential oxidant levels.

The base year used in this analysis (1974) was not the year with the highest reported oxidant level in Monterey County. Peak oxidant levels reached 0.136 ppm (corrected at 0.8 factor, see Appendix A-2) in 1971 and 0.128 ppm (corrected) in 1973. Due to changes in emission estimation procedures, changes in stationary source controls, and related factors, preparation of an adequate emission inventory for 1971 would pose several problems. However, county APCD estimates (Appendix A-3) indicate that 1971 and 1973 stationary source total hydrocarbon emissions were essentially the same. Based on the modified emission inventories for 1973 and 1974 (Table III of Appendix A-7), 1974 had the highest ratio of maximum oxidant level (monitoring station data minus natural background) to total reactive hydrocarbon emissions. Only if natural background oxidant levels exceed 0.021 ppm would 1973 be the most appropriate year to use in the rollback analysis.

Figure 44 presents the data from Table 47 in graphical form. This clearly indicates that if development actually occurs at the rate anticipated by local planning agencies and assumed as a basis for sizing the proposed project, the federal health-related air quality standards for photochemical oxidant will not be achieved and maintained during the period through 1995. Some individual years during this period may not report oxidant levels above the standards, but this will be due primarily to meteorological conditions more favorable than those experienced in 1971, 1973 or 1974.

On the other hand, if development actually occurs at a rate similar to that assumed for the Department of Finance D-100 projections, the federal oxidant standard may be temporarily achieved and maintained during the 1985-1990 period. Unless 1973 and 1974 truly represent "worst case" meteorological conditions (which is doubtful), at least an occasional violation of the federal health-related oxidant standard should probably be expected during the 1985-1990 period in Monterey County even under D-100 level growth.

Table 48 presents forecasts of potential maximum 1-hour nitrogen dioxide levels in Monterey County. The four alternative population/VMT forecasts discussed above were analyzed. The natural background level for nitrogen dioxide was taken from

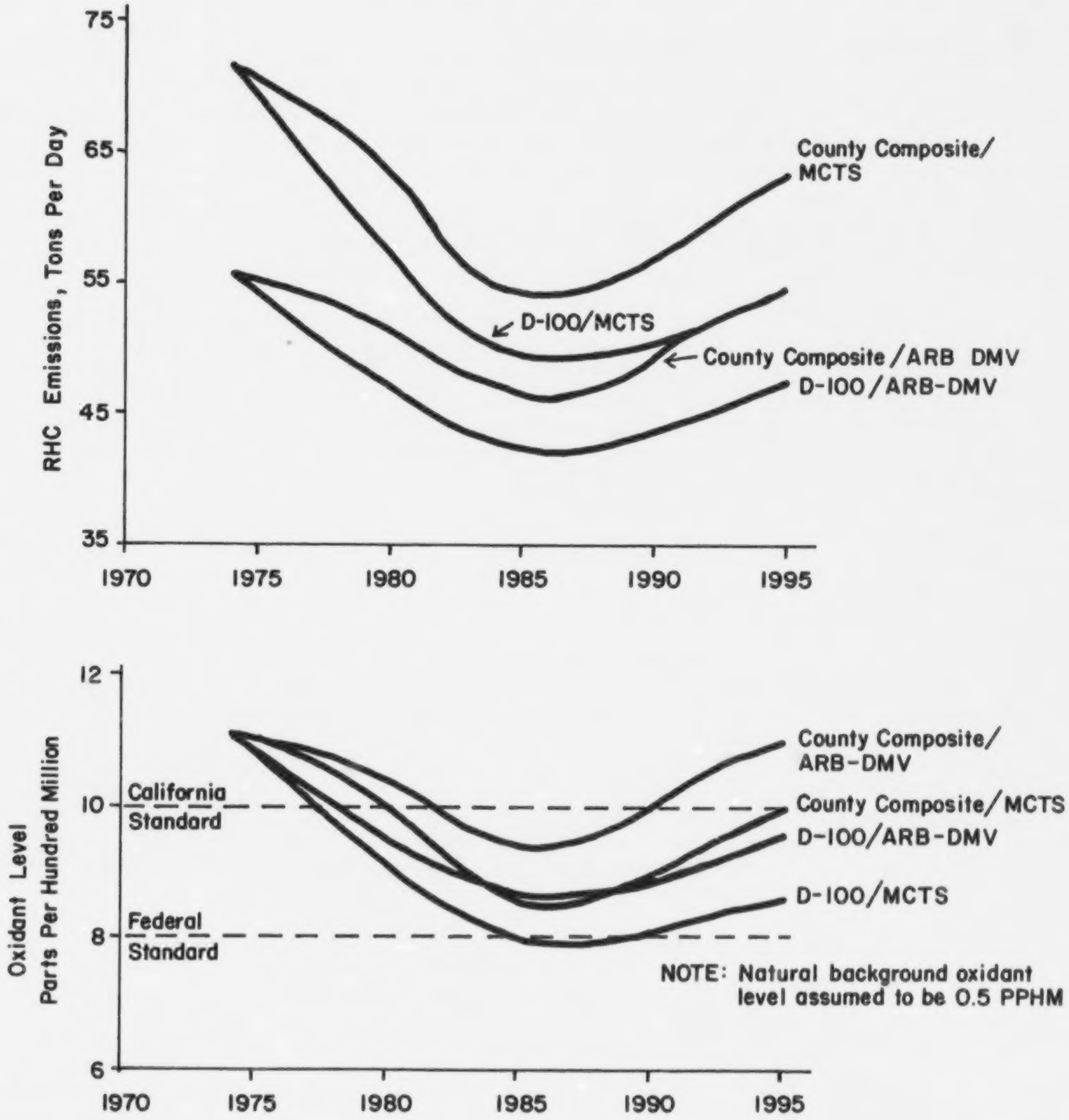


FIGURE 44 PROJECTED REACTIVE HYDROCARBON EMISSIONS AND RESULTANT POTENTIAL OXIDANT LEVELS ASSUMING ALTERNATIVE POPULATION VMT FORECASTS

Table 48

INFLUENCE OF ALTERNATIVE VMT ESTIMATES ON PROJECTED MAX-HOUR NO_2 POTENTIAL FOR MONTEREY COUNTY

VMT Forecast	Population Basis	Parameter	1974	1980	1985	1990	1995
Adjusted MCTS Data	D-100 Projection	Vehicle NO_x	29.5	28.2	27.7	30.5	34.5
		Total NO_x	67.6	86.4	98.7	116.1	115.0
		NO_2 level	0.15	0.191	0.217	0.255	0.252
Adjusted MCTS Data	County Composite Projection	Vehicle NO_x	29.5	31.2	30.5	33.9	42.2
		Total NO_x	67.6	91.7	104.7	125.4	132.7
		NO_2 level	0.15	0.202	0.230	0.275	0.291
ARB-DMV Data	D-100 Projection	Vehicle NO_x	20.5	19.5	19.0	20.8	23.2
		Total NO_x	58.6	77.7	90.0	106.4	103.7
		NO_2 level	0.15	0.198	0.228	0.269	0.262
Adjusted ARB-DMV Data	County Composite Projection	Vehicle NO_x	20.5	21.4	20.7	23.0	28.4
		Total NO_x	58.6	81.9	94.9	114.5	118.9
		NO_2 level	0.15	0.208	0.240	0.289	0.300

NOTES AND SOURCES:

Alternative VMT and population projections presented in Table IV of Appendix A-7.

NO_x = Oxides of Nitrogen. Motor vehicle and total NO_x emissions given as tons per day, annual average (values taken directly from or calculated using Tables III through VIII of Appendix A-7).

NO_2 = Ambient Nitrogen Dioxide level in parts per million (ppm) by volume (see Appendix A-4). California 1-hour ambient air quality standard for NO_2 = 0.25 ppm

Projected Max-Hour NO_2 potential based on unmodified "rollback" technique:

$$AQ_{fy} = B + (AQ_{by} - B) \times \frac{E_{fy}}{E_{by}}$$

Where: AQ = Ambient air quality (ppm)
B = Natural background pollutant level; 0.004 ppm (California Air Resources Board, 1974a)
E = Emissions of precursor pollutant; NO_x emissions, tons per day
by = Base year; 1974
fy = Forecast year

the 1973 annual report of the California Air Resources Board. This value correlates with the upper value for background NO_2 levels reported in Table A of Appendix A-1. The base year used (1974) had both the highest reported NO_2 reading and the highest ratio of observed NO_2 level to estimated NO_x emissions.

The data from Table 48 is presented graphically in Figure 45. This indicates that there is a definite potential for the California 1-hour NO_2 standard being exceeded in Monterey County from about 1987 on. Assumptions regarding either future VMT or future population levels in Monterey County will have relatively little influence on projected NO_2 levels until after 1990. This is due to the fact that the Moss Landing power plant is and will remain the source of about 30 to 40 percent of all nitrogen oxide emissions in the county. Power generation at this facility will be determined more by levels of development throughout much of northern California than by growth rates in Monterey County.

Recognizing that the preceding material deals with estimated air pollution potential, not actual forecasts of future air quality in specific years, the above discussion can be summarized as follows. Oxidant levels are projected to decline by 15 to 20 percent during the 1974-1990 period and increase by 8 to 10 percent during the 1990-1995 period. Nitrogen dioxide levels are projected to increase by 65 to 100 percent over the 1974-1995 period. Tables 47 and 48 indicate that state and local agencies should consider recommending Monterey County for designation by EPA as an air quality maintenance area (AQMA) with respect to photochemical oxidants, and perhaps also for nitrogen dioxide.

If such a recommendation were made by ARB and the formal designation adopted by EPA, an air quality maintenance planning program would be initiated in Monterey County. Assuming that procedures used elsewhere in California were followed, advisory and technical committees would be designated to reevaluate air quality problems. If this evaluation verifies that the county qualifies as an air quality maintenance area, additional committees would formulate and evaluate potential measures which could result in achievement and maintenance of air quality standards. These committees usually include representatives of local government, special districts, business and industry and various citizen groups.

A reevaluation of future air quality in Monterey County would provide an opportunity to assess various subareas of the county (such as the upper Salinas Valley, the lower Salinas Valley and Monterey Bay, and Carmel Valley).

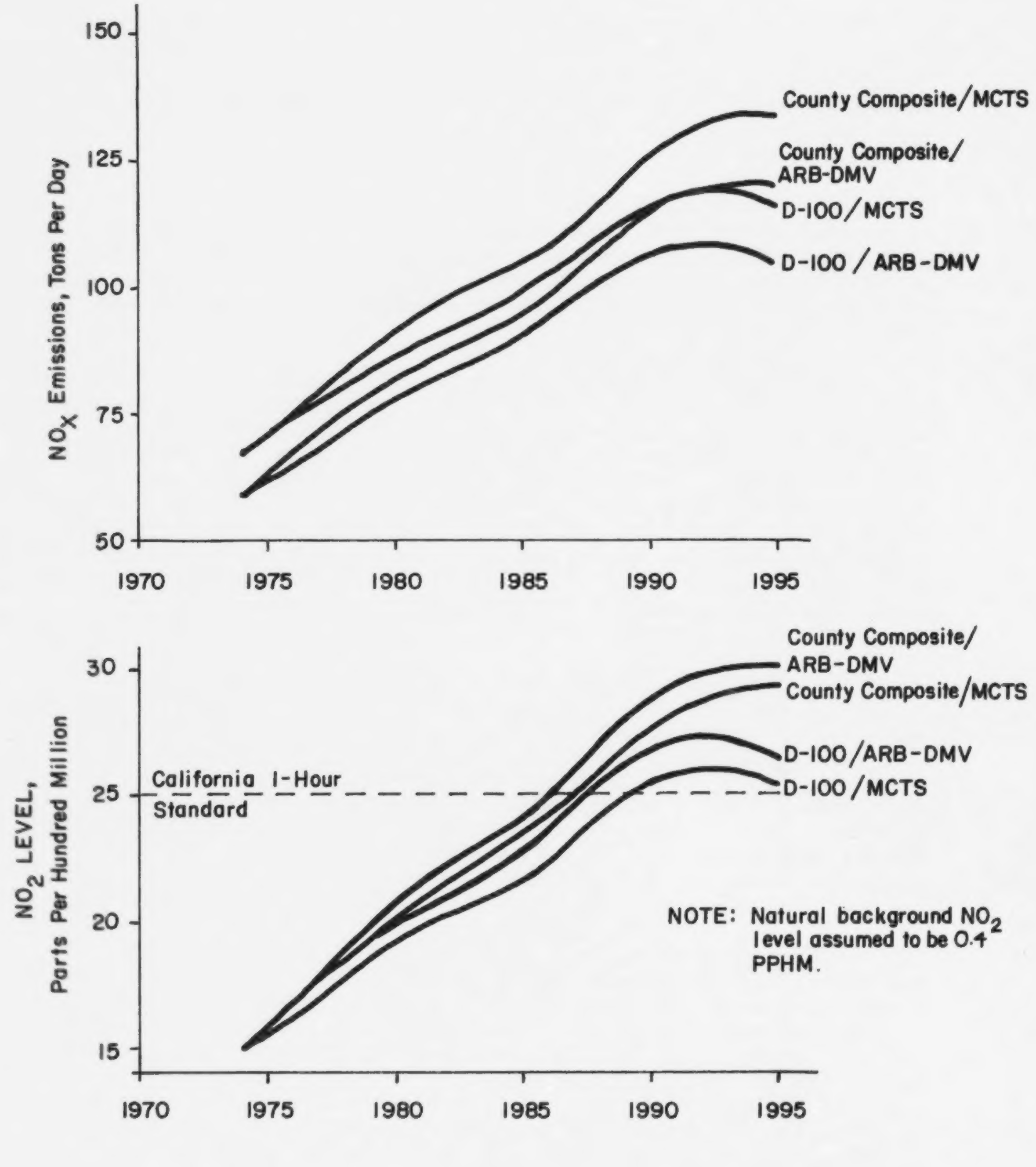


FIGURE 45 PROJECTED NITROGEN OXIDE EMISSIONS AND RESULTANT POTENTIAL NITROGEN DIOXIDE LEVELS ASSUMING ALTERNATIVE POPULATION VMT FORECASTS.

Such an evaluation of county subareas could be performed by using either a modified rollback analysis or a variation of the simple diffusion methodology of Hanna (1971). The possibility of pollutant influx from the San Francisco Bay area (either over the ocean or from the Santa Clara Valley) might also be investigated.

The potential maximum oxidant and nitrogen dioxide levels presented above have been discussed in terms of adopted state and federal health-related standards. The pollutant levels involved also have implications for agricultural crops important to the economy of Monterey County and California as a whole.

Both existing and potential oxidant levels are sufficiently high to cause either visible injury or yield reductions in sensitive crops. Detwyler (1972) cites oxidant values of 0.03 ppm for a 4-hour period as being a threshold for producing visible injury. Horsman and Wellburn (1976) cite several studies in which oxidant levels of 0.02 to 0.05 ppm for 2-3 hours produced various biochemical effects which might be expected to affect plant productivity. A 1-hour exposure to 0.10 ppm of ozone will often produce visible injury symptoms in such crops as spinach, tomatoes, pinto beans, oats, potatoes and muskmellon (Heath, 1975).

Nitrogen dioxide by itself is not very toxic to most plants. Few effects have been reported for even the most sensitive crops (peas, alfalfa, clovers, carrots, lettuce, oats, etc.) at exposures of 1.0 ppm for 24 hours (Taylor, et.al., 1975). The combination of sulfur dioxide and nitrogen dioxide at levels well below 1.0 ppm each for 1-4 hours can, however, produce significant damage to sensitive crops (Reinert, Heagle and Heck, 1975). A second major concern regarding nitrogen dioxide levels involves the role of nitrogen oxides in the formation of photochemical oxidants (see Appendix A-1).

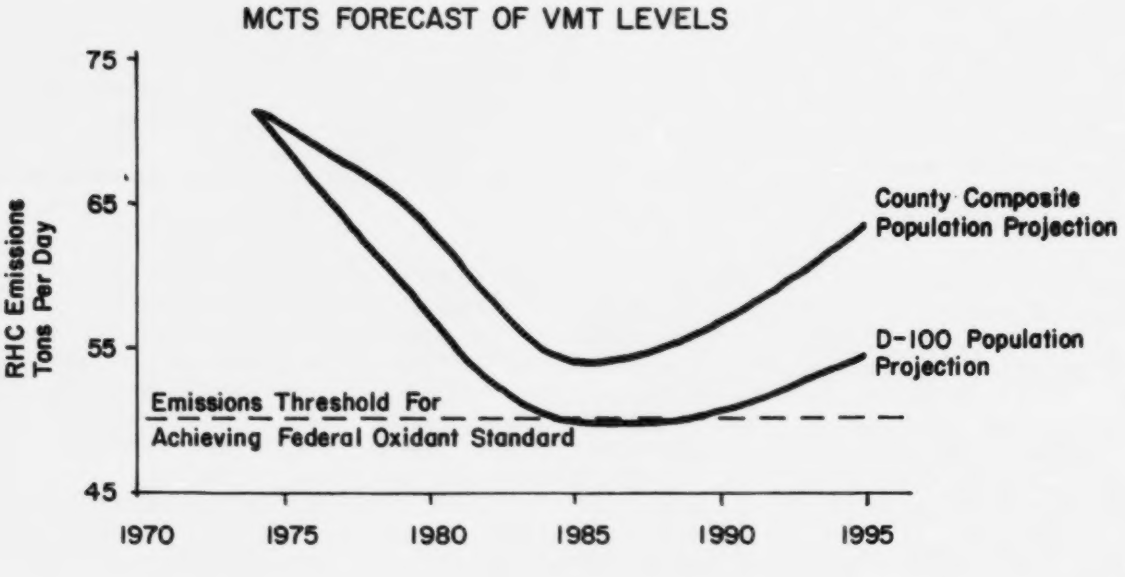
Mitigation of Growth-Related Air Quality Impacts. The rollback formula presented in Tables 47 and 48 can be used to determine an approximate emissions threshold correlated with the appropriate ambient air quality standard. Assuming a natural background oxidant level of 0.005 ppm, a 30 percent reduction in 1974 reactive hydrocarbon emissions will be necessary to achieve the federal primary oxidant standard. Reactive hydrocarbon emissions in Monterey County should be held to a level below 50.12 tons per day in order to achieve the federal oxidant standard, assuming that the MCTS values are the best estimate of current and future VMT. If the ARB-DMV values are assumed to be a more accurate estimate of current and future VMT, the reactive hydrocarbon emission threshold should be set at 39.04 tons per day. Similar emissions thresholds for oxides of nitrogen are 113.90 tons per day using MCTS VMT levels and 98.74 tons per day using ARB-DMV VMT levels. Figures 46 and 47 graphically illustrate the relationship of the reactive hydrocarbon and nitrogen oxide emissions projections to the emissions thresholds identified above.

Measures to achieve the emissions reductions identified above will require action by a large number of agencies. The Monterey Peninsula Water Pollution Control Agency lacks the legal authority to implement most of the measures which might be required. Those actions which MPWPCA might implement will have serious implications for the programs and activities in which other local agencies (especially city and county governments) are involved. But because it is a regional agency which provides service to local cities and unincorporated areas, MPWPCA is in a position to work with those local governmental agencies which can implement a variety of measures to mitigate the air quality impacts of continued development.

At the present time it is unclear if adequate institutional arrangements exists to ensure implementation of measures adequate to achieve the required air pollutant emissions reductions. Local agencies could develop and implement a program of mitigation measures on an individual basis or perhaps under the auspices of AMBAG. Designation of Monterey County as an air quality maintenance area would, however, provide a more definite mechanism for resolving this institutional issue. The following discussion identifies a variety of measures which collectively or individually might result in emissions reductions adequate to achieve and maintain the health-based ambient air quality standards for oxidants and nitrogen dioxide.

The primary actions which the MPWPCA could directly undertake involve reduced sizing of the proposed project or developing a program to limit the rate of flow increases to the treatment plant. Both of these actions would be intended to limit the rate of development in northern Monterey County to a level which would assure attainment and maintenance of the health-based air quality standards.

Either of the above actions would require coordination and cooperation from Monterey County and all of the cities in the project area to assure that the altered facility sizing or adopted flow limitations would be recognized and used as constraints on the amount and rate of future development. Reduced sizing of the proposed project would be the most direct means of assuring that the proposed project would not foster conditions which would interfere with attainment of air quality standards. The underlying assumption for such an action is that lack of capacity in the proposed facilities would in fact limit the rate



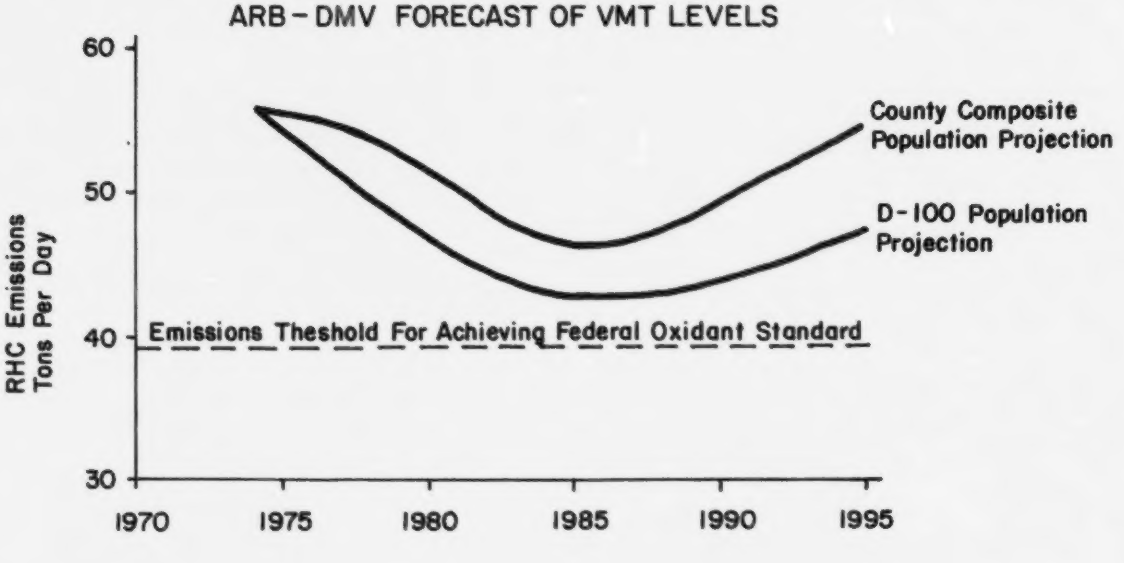


FIGURE 46 REACTIVE HYDROCARBON EMISSIONS PROJECTIONS BASED ON ALTERNATIVE VMT FORECASTS

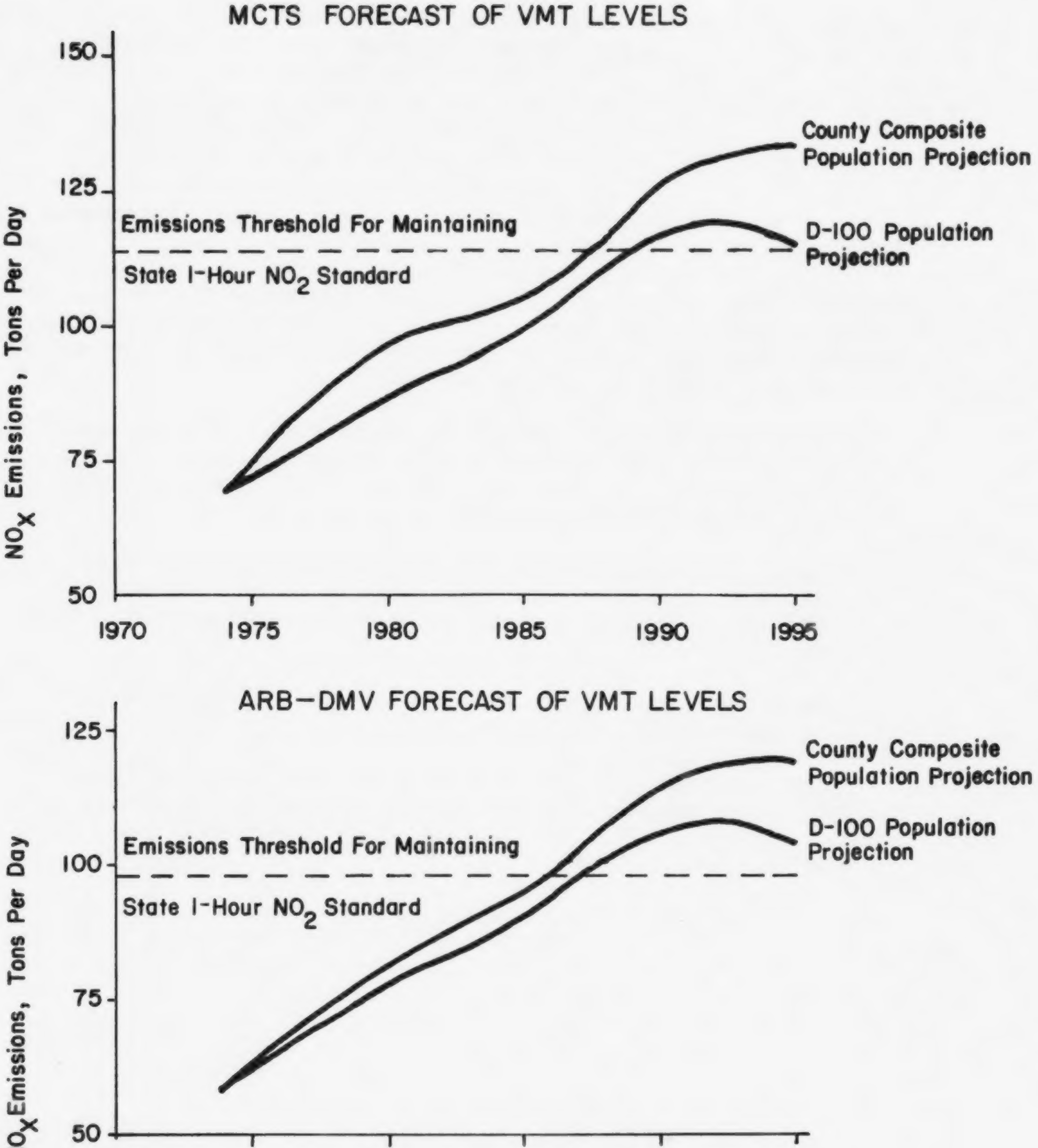


FIGURE 47 OXIDES OF NITROGEN EMISSIONS PROJECTIONS BASED ON ALTERNATIVE VMT FORECASTS

and amount of development in Monterey County to a level significantly below that presently anticipated by local planning agencies. This approach would be ineffective if alternative means of wastewater treatment and disposal were economically available, or if development pressures simply shifted to other areas in the county outside the project service area.

The flow limitation procedure is one being considered by the SWRCB in areas currently designated as air quality maintenance areas. It is uncertain if this procedure would be considered for the MPWPCA project, since Monterey County is not presently a designated AQMA. The flow limitation would be imposed through the following type of condition on the award of Clean Water Grant funds to MPWPCA.

> "Grantee agrees the average dry weather flow of wastewater to be treated and/or conveyed by the proposed project (system) will not exceed ______ MGD for a period of ten years after the date of concept approval, unless, prior to that time:
>
> (a) There is a demonstration to the satisfaction of the State Air Resources Board that adverse air quality impacts related to flows in excess of the above limit are mitigated; or
>
> (b) An Air Quality Maintenance Plan is developed and approved by the state.
>
> "No commitment of treatment or conveyance in excess of the above limitation shall be made by the grantee during the period while the flow limitation is in effect." (California State Water Resources Control Board, 1976).

This approach has not yet been formally accepted by EPA as an adequate means of mitigating the indirect air quality impacts of a project. Grant funds for treatment plant facilities are awarded on a 10-year capacity basis (as determined by the Department of Finance D-100 projections) in order to equitably distribute limited federal and state funds among numerous projects. Thus acceptance of the flow limitation procedure implies a recognition that measures other than growth limitations will, within a 10-year time frame, prove adequate for achieving and maintaining ambient air quality standards.

Potential legal problems for implementing a flow limitation condition to the proposed project have not been thoroughly investigated. Service contracts between MPWPCA and the local agencies served by the regional treatment plant might require revisions to allow implementation and enforcement of any flow limitation.

The following discussion identifies measures which other local, state or federal agencies could utilize to mitigate the air quality impacts of continued development in Monterey County.

The data in Tables 47 and 48 (see also Appendix A-7) indicate that mobile sources are currently the major emitters of both reactive hydrocarbons and nitrogen oxides. By 1980, stationary sources will become the major source of nitrogen oxide emissions. By 1990, stationary and miscellaneous area sources combined will about equal mobile sources in emissions of reactive hydrocarbons. These factors must be considered in developing a program to mitigate the growth-related impacts of the project.

Stationary source emissions can be approached on two levels: imposing increasingly stringent emission regulations; and denying approval of significant new stationary sources of air pollutants. Regulation of stationary source emissions is primarily the responsibility of the local Air Pollution Control District. The major existing stationary sources of reactive hydrocarbons are petroleum marketing operations, pesticide use and solvent-using industries. The major stationary sources of nitrogen oxide emissions involve power plants and industrial fuel combustion.

Stationary source reactive hydrocarbon emissions could be reduced through such measures as reduction in the use of organic solvents containing volatile reactive hydrocarbons (curtailment of use or substitution of other solvents); catalytic oxidation, carbon adsorption, or incineration of organic solvent vapors from paint spray booths and other sources; increased use of gasoline vapor recovery systems at gasoline storage facilities; or reductions in gasoline volatility through the use of chemical additives or changes in gasoline composition. The technical, legal and economic problems of implementing these measures would require careful study.

Reductions in stationary source nitrogen oxide emissions would probably involve modification of industrial and power plant boiler operations, flue gas recirculation, etc.

City and county governments and the local air pollution control district have significant control over the development of new industrial sources of pollution. City and county general plans, zoning ordinances, and conditional use permit procedures provide several mechanisms for controlling the type and location of new industrial sources which might become established in Monterey County. The local air pollution control district must set emissions limitations and issue permits to construct and operate such new stationary sources. Permits for construction and operation of new stationary sources can be denied by the APCD if emissions from the proposed source would violate emissions limitations or interfere with attainment or maintenance of ambient air quality standards. ARB could also become involved in the review of proposed stationary sources, since it exercises oversight responsibilities regarding local APCD activities. New source emission standards for certain types of industries have been set by EPA, although local APCDs and ARB have primary implementation responsibility.

Any action taken to deny or impede the development of new industry will alter the future economic base of the county and any affected city. This change will affect the amount of new development which should be anticipated in the county, implying a reduction from current land use, population and wastewater flow projections.

The U. S. Environmental Protection Agency, the California Air Resources Board and local governments all have significant roles in devising programs to reduce motor vehicle emissions. The EPA and the ARB have direct regulatory control over vehicle emissions. The effects of existing vehicle emission control regulations are incorporated into the projections of future emission levels presented in several preceding tables and figures. As can be seen from Table 47, motor vehicle reactive hydrocarbon emissions are expected to decline from current levels. What the table does not show is that by 1980 or 1985 evaporative emissions of hydrocarbons (from hot engines) will be as important as exhaust emissions (California Air Resources Board, 1976b). As such evaporative emissions become more important, reducing the total number of vehicular trips will become as important as reducing the total vehicle miles traveled. The emission factors used to develop the data in Table 47 incorporate these evaporative emissions on a VMT basis, not on a vehicle trip basis.

While it is possible that future technological improvements will allow control of reactive hydrocarbon emissions beyond the level specified by current standards, there is no way at present to quantify this potential reduction. Action to require implementation of such new technology would be the responsibility of the ARB and EPA.

A major shift in vehicle fuels (such as to propane or alcohol-based fuels) could produce important reductions in reactive hydrocarbon emissions, but such a change appears highly unlikely in the near future.

City and county governments can play a key role in controlling future mobile air pollution sources through modifications to general plans, zoning ordinances, and conditional use permit procedures. These land use controls can be used to guide the pattern of residential, commercial and industrial development in such a way as to minimize motor vehicle use.

General plans could be revised to redirect the type, amount, location and rate of development in a manner which will assist in achieving or maintaining air quality standards. In addition to possible political difficulties in achieving such a comprehensive reevaluation of local general plans, there are practical difficulties of accurately estimating the air quality consequences of plan revisions and of devising procedures to ensure implementation of air quality goals.

Local planning agencies can play an important role in controlling vehicle travel through regulation of land use patterns. Numerous measures to reduce mobile source emissions are possible. Some of the major ones which could be important individually or cumulatively are discussed below.

General plans should be reviewed and modified as necessary to ensure that any new employment centers will be near the probable residential areas for most employees. This action would reduce VMT for job-related trips. This approach could be implemented by city and county governments through normal general plan review processes. Implementation of these initiatives should not be very difficult, but their enactment would produce only a minor decrease in overall VMT levels.

General plans could also be reviewed and modified as necessary to provide for higher density or clustering of residential development, with neighborhood and community rather than regional commercial centers. This could reduce the length of local trips (to shopping, school, parks, etc.). In conjunction with several of the following measures, this planning procedure offers the potential for a modest or perhaps significant reduction in vehicular trips and VMT. This step could be implemented by city and county governments through normal general plan and development review processes. However, its implementation may generate local controversy, especially in areas which are trying to maintain a rural residential atmosphere.

New residential areas and their associated roadways can be designed to facilitate bus service. Roadways can be designed with bus turnouts at appropriate locations. Higher density developments and linear development clusters are most efficiently served by bus systems (as opposed to extensive lower density tract development). The influence of urban form on the costs of other urban services and on VMT levels for those who travel by private auto must also be considered. Total vehicular trips and VMT can both be reduced by this measure. The extent of such reductions will depend greatly on the effectiveness of the transit system operating in the area and on the existing "urban form" of the area. This measure can be implemented by city and county governments through general plan and specific development review processes. Coordination should be maintained with the agency which is to be responsible for transit service.

Neighborhood circulation systems should be designed to emphasize pedestrian and bicycle modes of circulation for intra-neighborhood travel (i.e., to schools, parks, and local commercial areas, etc.). This has the potential for a modest reduction in vehicular trips and VMT. Implementation may require changes in the policies of local general plans and will require careful evaluation of specific development plans at the local level. There may also be a potential for increasing the convenience of pedestrian and bicycle travel in existing developed areas.

Community-wide bicycle circulation systems should be developed to meet inter-neighborhood travel desires (trips to local employment centers, certain types of shopping, schools, parks, etc.). The effectiveness of this proposal would probably be dependent on local attitudes toward nonvehicular travel as well as on the convenience of the facilities provided. Any shift from vehicular to nonvehicular travel modes, however, will be important to achieving air quality goals. Implementation will require planning and capital improvement actions by local government. There may be a potential for technical assistance and funding from other levels of government.

Existing public transit systems could be expanded and improved to attract greater ridership. Such systems must meet both inter-city and intra-city travel desires. The system would have to be both convenient and low cost (i.e., subsidized) to be effective. Planning of the system should recognize both employment and shopping travel patterns. Attention should also be given to meeting travel demands associated with major recreational facilities or areas. Experience elsewhere indicates that an efficient transit system has the potential for attracting 10 percent (or perhaps more) of the total travel demand in an area (U. S. Environmental Protection Agency, 1974). A much higher percentage attraction is possible during the morning and evening commute hours.

State agencies (CalTrans) and local government could provide technical and administrative support service for car pool formation. Assistance to major employees in organizing employee car pools might be the most effective procedure. Programs such as those developed by the 3M Company of St. Paul, Minnesota might also be instituted.

Local cities could take action to increase the cost or restrict the availability of parking at certain employment or shopping areas, giving cost advantages or priority to car pools. Local employers could be encouraged to take similar actions. Major attempts to implement such measures would probably generate significant local opposition.

Large employers could be encouraged by local agencies to utilize staggered working hours. This would reduce current peak-hour traffic volumes and spread higher traffic flows over a longer period of time. It is uncertain what effect this would have on daily peak oxidant levels.

Large employers might also be encouraged to utilize a staggered 4-day work week. This would reduce employment-related trips and VMT, but might lead to increased shopping and recreational travel. The net effect of such a measure is uncertain at present.

Vegetation and Wildlife

Wastewater treatment service areas are projected to be expanded in several portions of the study area as a result of the project. These include Prunedale and Castroville, Moss Landing, the Monterey/Salinas corridor (Del Rey Oaks, Toro area on Highway 68), the outskirts of Salinas and Marina.

Future development within these portions of the service area would result in impacts on existing vegetation and attendant wildlife. Vegetation would be removed from developing areas. Adjacent lands would be subjected to heavier human use. This characteristically results in loss of vegetation through trampling, use of off-road recreational vehicles and cutting for firewood or clearing for a variety of reasons. Increased runoff from paved and builtup areas often accelerates erosion and leads to removal of or a change in vegetation in adjacent areas.

Wildlife populations are most seriously affected by the loss of habitat. The area available for shelter, feeding and reproducing is reduced, forcing some animals to relocate into adjacent areas. This increases population density and competition for food and living space, and often results in an overall reduction in numbers of animals. Some habitats are in shorter supply and therefore more critical than others (i.e., salt marsh, riparian vegetation, coastal dunes). Increased human use of lands adjacent to new developments also affects the more timid and secretive wildlife species. Changes in local drainage patterns and contents of overland runoff created by development can be major influences on the quality of riparian and marsh habitats downslope.

Five vegetative types would likely or may be impacted -- agricultural (cultivated), woodland/grass, coastal dunes, riparian and coastal salt marsh.

Agricultural. Key agricultural lands are located adjacent to Salinas, Castroville and Prunedale. Most of these lands are in cultivation and have little natural vegetation, but do have periodic use by wildlife.

Woodland Grass. Woodland and woodland/grass vegetative types are scattered throughout the service area. The greatest impacts on woodland areas resulting from growth would be in the Monterey and Salinas corridor (Highway 68). Oak woodland ranks as an important habitat for wildlife in terms of species diversity and population numbers. Encroachment into this habitat type by residential and/or commercial development will reduce local populations of wildlife and reduce the value and use by many seasonally abundant species.

Coastal Dunes. Projected service area expansion could include some coastal dune habitat north of Marina and south of Moss Landing. Any development in this habitat could impact small mammals (blacktailed jackrabbits, brush rabbits, Microtus) and bird fauna utilizing the dunes and beach areas.

Riparian. Riparian habitat borders the Salinas River along most of its length within the study area. The greatest potential impact on riparian vegetation would be on the south side of the river in the Toro area along Highway 68. Riparian woodland represents a valuable habitat to wildlife because of vegetative variety and the close proximity to water. Any encroachment into riparian areas would reduce species diversity and population numbers.

Coastal Salt Marsh. The potentially expanded service area at Moss Landing would abut salt marsh habitat at Elkhorn Slough and Old Salinas River. Much of the land surrounding Elkhorn Slough has already been converted to non-resource use -- urban development and commercial and industrial uses. Any further land use changes within or immediately adjacent to salt marsh areas would affect the existing wildlife values and habitat for numerous species of waterfowl and shorebirds and invertebrate life forms.

Several rare and endangered vertebrate species could be impacted by population growth and urban or commercial development. The California clapper rail is a resident of salt marsh habitats at Elkhorn Slough, while the brown pelican and least terns are migrants, seasonally utilizing the habitat provided by Elkhorn Slough. The Santa Cruz long-toed salamander inhabits vernal pools in the Moss Landing area. Any disturbance of these pools could reduce available habitat and population numbers. Urban encroachment into the sand dunes between Monterey and Marina could further reduce the habitat and viability of the Smith's blue.

Numerous rare and endangered plant species occur throughout the study area, some of which likely occur within the expanded service areas. Many of these species are associated with coastal sand dunes and the coastal strand.

Mitigation or avoidance of growth-related impacts on vegetation and wildlife is best achieved through the land use planning process. Within northern Monterey County, this planning is primarily the responsibility of the incorporated cities, Monterey County and the California Coastal Zone Conservation Commission. Official land use plans and accompanying zoning restrictions are responsible for identifying appropriate land uses and regulating the pattern of future land development. These plans should take into consideration the existing pattern of vegetation and wildlife habitat within the study area and provide appropriate protection from changes in land use within and adjacent to those vegetation and habitat types found to be worthy of such protection. Habitats that include rare or endangered species of plants and animals (coastal dunes, salt marsh, freshwater marsh), habitats in limited supply (salt marsh, riparian areas) and habitats that support unusually diverse or exceptionally large numbers of species (salt marsh, riparian areas) should be specifically identified and a mechanism should be established to insure their protection. The California Coastal Zone Conservation Commission has identified many of the study areas valuable coastal habitats in their Coastal Plan and has identified methods for their protection.

Growth-related increases in erosion, stream siltation and urban runoff can also affect vegetation and wildlife. These secondary impacts must be controlled on a local level through strict enforcement of grading ordinances, required control of runoff from construction sites, and improved methods of either controlling, reducing or improving the quality of urban runoff. AMBAG is currently conducting a 208 study of non-point source pollution in the Monterey-Salinas area. This study should identify means of reducing the impacts of erosion and urban runoff on water quality, and therefore wildlife and vegetation.

The specific impacts and ramifications of population growth and development on wildlife and vegetation must also be analyzed in impact reports for each new area developed in the future.

Resource and Energy Use

Continued growth entails the use of many different resources. Most mineral and energy resources are essentially nonrenewable. Other resources, such as food, timber, water and wildlife are renewable if used and managed properly (renewable resources are capable of being naturally replaced in a reasonably short period of time). The extraction, harvesting and processing of resources produces a variety of environmental effects. Maximizing the production of renewable and nonrenewable resources to better support continued growth entails social and environmental costs.

Mineral extraction and timber harvesting reduce the recreational, aesthetic and wildlife values of the land involved through clearing of vegetation and scarring of the landscape. Runoff from extraction areas often pollutes waterways and destroys fisheries habitat. Use of materials for construction of structures roadways, etc. preempts alternative land or resource use. If the resource is nonrenewable, the supply available to future generations is also reduced.

If growth in the proposed facilities service area proceeds as projected (Table 45), annual residential natural gas usage and electrical consumption will increase proportionally (assuming per capita consumption rates remain the same). Commercial and industrial energy use should increase at a similar rate, even though it is difficult to project the type and amount of commercial-industrial development that will occur in the study area. The larger populations will also require increased energy supplies for transportation. If residential development proceeds as projected in county and local plans, the new residents will, on the average, live further from their jobs than is now the case. Development in the Castroville-Prunedale area, the Monterey-Salinas corridor and the outer edges of Salinas will require higher per capita commute distances to the job market areas. All of these increases in energy demand will in turn require additional development of renewable and nonrenewable energy resources; most of these resources are currently being tapped outside the study area.

If local water supply shortages are not solved locally through increased development of existing surface and groundwater, increased use of reclaimed wastewater or improved water conservation efforts, water will have to be imported from other drainage basins to meet the needs of the increasing population. This will in turn require major expenditures of energy and construction materials to develop a delivery system and transport the water into the area.

Resources other than energy are also required to support development. Lumber and forest products, sand and gravel and a variety of other construction materials go into building houses, roads and service establishments for new residents. Sand and gravel and clay products are extracted and manufactured within the county, while wood and metal products are generally imported.

These potential impacts on energy and resource supplies can be controlled to a degree by initiating simple conservation-oriented planning policies on a local scale. This could include incorporating energy conservation requirements into building codes, encouraging local mass transit systems, encouraging urban areas in-filling rather than urban sprawl, publicizing household-oriented energy and resource conservation techniques in schools and the local media, conducting local energy education campaigns and utilizing local rather than imported resources (water, gravel, etc.) as much as possible.

Aesthetics

The major adverse aesthetic impacts normally associated with urban expansion include removal of vegetation, obstruction of previously natural vistas, elimination of open space and the slow accumulation of noises, odors and aerial contaminants that come with many residential, commercial and industrial areas. If growth in the study area follows the directions indicated in local and county plans, aesthetic impacts will be felt in a variety of locations.

The Monterey-Salinas corridor, the Castroville-Prunedale corridor and the undeveloped lands surrounding Marina and Salinas are likely targets for new development. The Monterey-Salinas and Castroville-Prunedale corridors are already changing from rolling, tree-covered thoroughfares to low density residential suburbs. If water and wastewater services continue to be made available in these areas, the conversion of the landscape will probably continue. County and City of Monterey General Plans indicate development in the Toro Park and Monterey II areas will continue well beyond the boundaries of existing development. This is also evidenced by the boundaries of this project's service area. New zoning designations in the

Castroville-Prunedale corridor require extremely large lot sizes due to the poor soil and groundwater conditions and their effect on septic tank use.

Urban expansion on the Marina and Salinas outskirts would have a less pronounced effect on regional aesthetics. These areas are currently dominated by a combination of urban and agricultural activities that exist in close proximity to one another.

Sewering of the Moss Landing area, which is planned as a subpart of the north Monterey County Facilities Plan, may slightly alter the scenic character of that community. The facilities are being planned for a relatively small population increase, but the present rural atmosphere may give way to a more suburban setting with residential and commercial in-filling.

These potential impacts of growth require no mitigation if changes from rural and open space settings to suburban landscapes and increases in urban densities are considered aesthetically desirable. However, if one considers open space and lower development densities to be more pleasing, many of the aesthetic impacts can be reduced while still experiencing growth. Controls on the location, type and extent of residential and commercial structures through zoning restrictions can have a significant effect on aesthetics.

Building setback restrictions, tree cutting ordinances, landscaping requirements and architectural style recommendations are also tools that can be used to influence the aesthetics of developed areas. The use and effectiveness of these mitigations is dependent upon the policies and actions of the County Planning and Public Works Departments and the Board of Supervisors. The county's Open Space Element (Monterey County Planning Commission, 1972) includes broad policy statements designed to protect the natural, aesthetic values of the county's open land. The California Coastal Plan also includes recommendations for maintenance of the scenic coastal corridor. Strict application of these recommendations should mitigate many of the aesthetically undesirable potential impacts of development.

SUMMARY ANALYSIS OF ALTERNATIVES AND RECOMMENDATIONS

The following paragraphs briefly summarize the impacts of the various alternative pipeline routes, treatment plant sites and complete wastewater treatment and disposal systems. Recommendations of most acceptable alternatives are made where appropriate.

Pipeline Routes

Alignments A1 and A2

The possible destruction of rare and endangered plants on Ft. Ord is the major adverse environmental impact likely to be created by construction on Alignments A1 and A2. Neither alternative avoids the identified plant locations; therefore, this particular impact should not play a role in deciding between the two routes. However, close field inspection and control of construction activity in the potential impact areas is called for if construction is to follow either route. The major traffic and commercial business disturbances created by excavation along Del Monte Boulevard appear to be the most significant environmental consideration in choosing between Alignments A1 and A2. The minor habitat loss and wildlife disturbance created by construction on A1 can be mitigated and is of less magnitude than the traffic impact created by using Alignment A2. Therefore, A1 appears to be preferable.

Alignments B1 and B2

There appears to be very little difference in the environmental impacts of using Alignments B1 and B2 except that route B2 may encroach on an area inhabited by a rare species of plant. If B2 is to be used, a detailed site investigation should be conducted to verify the presence or absence of the rare plant. If the plant is present, route B1 should be used. If it is absent, either route should be acceptable.

Alignments C1 and C2

There are no alternatives to Alignments C1 and C2.

Alignments D1 and D2

Temporary traffic, commercial and residential disruptions are the major environmental problems associated with Alignments D1 and D2. It appears that route D1 through Marina is superior to D2 in that significant traffic and residential disruptions and the possible loss of a number of large trees would be avoided in favor of construction between the highway and the railroad track (D1), which would create only a moderate traffic problem on State Highway 1.

Alignments E1, E2, E3, E4 and E5

Rate of energy consumption and threat of pipeline damage during a seismic event appear to be the most significant long-term impacts associated with construction along these proposed routes. Alignments E3 and E4 cross the concealed Reliz-Renconanda fault in the vicinity of the Davis Road-Reservation Road junction. E1 and E4 cross it again where they turn northward just north of Marina. These routes would therefore be exposed to the greatest threat of rupture from fault offset. Alignment E2 would create short-term traffic problems along Blanco Road, but avoids the fault Route E5 avoids both the traffic problem on Blanco Road and the fault. E5 also has the lowest anticipated rate of energy consumption (see Table 29). Route E5 therefore appears to be the most acceptable for construction of a Salinas interceptor.

Alignments F1 and F2

Interference with agricultural operations would be less severe if pipeline construction followed Alignment F2 rather than F1. Therefore, it appears that route F2 is more acceptable than route F1.

Ocean Outfalls (Land Portion)

Four land-based ocean outfall routes have been proposed (see Figure 32). Routes 1 and 2 cross agricultural land and beach sand dunes, and border the California Department of Fish and Game wildlife area near the mouth of the Salinas River. Excavation through the dunes and disturbance to agricultural operations and wildlife can be avoided by other routes. These two routes do provide the opportunity to supply the wildlife area with treated wastewater for habitat enhancement; however, water quality requirements for use in the area may exceed the expected quality of the ocean discharge, preventing this reuse. Reuse requirements should be checked through the RWQCB and the

State Health Department. If the wastewater cannot be reused, these two routes appear to be the least desirable. Route 4 avoids impacts to the wildlife area, but a significant parcel of agricultural land would be temporarily lost and the farming operation would be disrupted if it were used. Route 3 avoids all potential agricultural and wildlife problems and follows an existing transportation right-of-way. There may be a temporary disruption of the sand mining operation at the end of the right-of-way, but this could be adequately mitigated by avoiding the existing road or by providing a temporary route to and from the site. It therefore appears that Alternative 3 is environmentally the most acceptable as an outfall alignment, pending determination of the feasibility of using wastewater on the state wildlife area.

Specific routes (and alternate routes) for the irrigation delivery pipeline of Alternatives 134, 166, 170 and 171, and the lagoon outfall of Alternative 134 have not been developed to date. The irrigation delivery pipeline route is dependent on the outcome of the agricultural demonstration project and the location of the irrigation distribution system to be utilized for wastewater reuse. The route of the lower river outfall of Alternative 134 has not been studied in detail as Alternative 134 is not the facilities engineer's recommended plan.

Treatment Plant Sites

Seismic and energy considerations, potential land use conflicts and aesthetic impacts are the most important environmental factors in choosing one of the six treatment plant sites. All six sites are predominantly open agricultural land, but the five south of the Salinas River are within the City of Marina's sphere of influence and the one north of the river is within the Castroville sphere of influence (sphere of influence being the county planning area that surrounds these communities). Sites 3 and 6 occupy prime agricultural land and are currently under cultivation. Both of these sites have been designated by local area plans for continued agricultural use (Marina Master Plan, 1967; Moss Landing Area Development Plan, 1973). Dedication of this high value agricultural land to wastewater treatment use is not desirable.

The remaining four sites are primarily grazing land. Site 4 also contains part of the Marina landfill. Soil conditions are essentially the same. Sites 1 and 2 are readily visible from both the existing and new State Highway 1 routes, while Sites 4 and 5 have areas that are screened from off-site view. Portions of Sites 4 and 5 are designated by the Marina Master Plan (Monterey County, 1967) for urban expansion, while

Sites 1 and 2 are located on land designated as industrial reserve. These future use designations may be subject to change now that Marina has incorporated. If urban development does take place in Sites 4 and 5 as the plan suggests, location of treatment facilities there may not be compatible with development, especially if residential use is involved. It is unlikely, however, that urban development will encroach on the Marina landfill site, as it is expected to become the major landfill in the north county. Wastewater treatment would be quite compatible with landfilling; the close proximity of the two would also make sludge disposal relatively inexpensive.

The general seismic data available in the Burland and Associates (1975) report indicates that seismic risks are quite uniform over the six possible plant sites with the exception of the eastern half of Site 4. This higher ground has slightly less risk of lateral spreading, vibration damage and ground rupture.

Energy consumed in pumping to the treatment plant would be highest for Site 4 and lowest for Site 1, but that consumed for pumping to irrigation in the Salinas Valley and disposing of sludge would be lowest for Site 4 and highest for Site 1. Sites 2 and 5 fall in between in each case.

Based on these considerations, it appears that locating the treatment plant on Site 4 near the Marina landfill would have the fewest adverse environmental consequences. The close proximity for sludge disposal and the possibility of sludge reuse for landfill cover, the compatibility of land uses and the general remoteness of the area are all favorable aspects. In addition, the possibility of using methane generated at the landfill for treatment plant power is increased if Site 4 is used.

Treatment and Disposal Systems

Five alternative regional wastewater plans and the no action alternative have been described and analyzed in detail in the preceding sections. Several major environmental, social and economic considerations have been identified in the process. These key potential impacts and their interrelationship with the project alternatives are listed in Table 49. This information is the basis for the comparison of alternatives which follow.

Table 49

SUMMARY EVALUATION OF ALTERNATIVE TREATMENT AND DISPOSAL PLANS

	Alternatives[1]					
Potential Impacts	1	134	166	170	171	No Action
PHYSICAL-BIOLOGICAL IMPACTS						
Archeological resources	P	P	P	P	P	N
Air quality	A	A	A	A	A	A
Soils and crops	N	P	P	P	P	N
Agricultural practices	N	P	P	P	P	N
Seismic risks	A	A	A	A	A	A
Groundwater quality	N	B	B	B	P	A
Surface water quality	B	B	B	B	B	A
Monterey Bay water quality	B	B	B	B	B	A
Water supply and reuse	N	B	B	B	B	N
Public health - water contamination	B	B	B	B	P	A
Public health - land contamination	N	A	A	A	A	N
Energy consumption in treatment and disposal of wastewater (rank)[2]	2	6	4	4	3	1
Aesthetics	B	B	B	B	B	A
Land use changes	N	A	P	A	A	N
Salinas River biota	A	P	A	A	A	N
Salinas River lagoon biota	P	B	P	P	P	P
Marine biota	B	B	B	B	B	N
General construction impacts (rank)	A	A	A	A	A	N
ECONOMIC IMPACTS						
Construction cost (rank)	3	5	4	6	2	1
Operating cost (rank)	2	6	3	5	3	1
Local cost (rank)	3	5	4	6	2	1
Overall cost (rank)	3	5	4	6	2	1[3]
SOCIAL IMPACTS						
Growth inducement - accommodation	A	A	A	A	A	N
Local acceptance	A	P	P	P	P	A

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[1] Key:

B Beneficial
A Adverse
P Problematical (unknown or open to question)
N None

[2] Comparative ranking from most acceptable (#1) to least acceptable (#6) alternative.

[3] Ranking does not consider possible economic penalties for noncompliance with RWQCB NPDES permits.

The main objective of the north Monterey County facilities planning effort has been to find a solution to existing water quality and public health problems being created by existing wastewater systems. At the same time, methods of alleviating groundwater quality and quantity problems in the study are being sought. The solutions must be implementable, locally acceptable and cost effective. Therefore, the water quality and public health implications of the project alternatives and their social, economic and environmental costs, are vital to selection of the most appropriate alternative.

Each of the five proposed regional alternatives would solve the major public health and water quality problems associated with existing wastewater discharges. The no action alternative would perpetuate the problems. Alternative 1 would relocate all discharges to central Monterey Bay where new problems are not likely to develop. The four reclamation alternatives would discharge effluent to various land or surface water areas, with varying potentials for creating new water problems. The two storage alternatives (170 and 171) would apply the most wastewater to croplands and therefore have the greatest risk of eventually degrading the surface aquifer in the lower Salinas Valley and increasing quality problems associated with agricultural runoff. They also have the best potential for reducing water supply and salt water intrusion problems. Alternatives 134 and 166 would apply less wastewater to croplands, but would require nonirrigation season discharges to surface waters. The Alternative 166 discharge to the bay would be less likely to create a surface water quality or public health problem than the Alternative 134 lower Salinas River discharge, even though the river discharge would probably improve river and lagoon water quality in low flow periods. Despite these potential new problems, the reuse aspect of the four reclamation options is a significant environmental benefit to the water-short study area; this is of major importance in selecting a final project.

There are several other areas of impact that are important to the selection process and therefore need to be mentioned. The first is impact on the area's flora and fauna. All five of the proposed regional alternatives would have an adverse but mitigatible effect on fish, wildlife and vegetation along the lower Salinas River from removal of the Salinas discharges. Because each alternative, except no action, has the same effect, this will not play a role in selecting a best project. Alternative 134 could, however, benefit the fish and wildlife resource in the Salinas River lagoon by providing a large freshwater source during the nonirrigation season.

The major social and economic considerations include cost of the new system, impact on existing land uses and general public acceptability. No action appears to be the cheapest option at the outset, but fines for noncompliance with RWQCB discharge permits would ultimately make this choice economically prohibitive. Beyond that, Alternative 171 would have the lowest cost over a 20-year period, with Alternative 1 a close second. Alternative 166 costs are approximately $11-$13 million higher than 1 and 171 for the construction phase. Alternative 134 is $5-$13 million more costly than 166 in the construction phase. Alternative 170 has by far the highest cost.

While no action and Alternative 1 would have little impact on land use, the four reclamation alternatives could have a significant impact on agriculture in the Castroville area. Long-term use of wastewater for irrigation could adversely affect the viability of soils and require costly changes in farming practices. Crop marketability could also be adversely affected. In contrast, the new water source could prolong the viability of farming in areas that are facing a rapid deterioration in the quality of existing groundwater supplies. These impacts would be studied in detail through a pilot project prior to initiating full-scale irrigation reuse.

Alternatives 170 and 171 would displace large acreages of open space for storage/percolation areas. These new uses could conflict with urban expansion planned in the Marina area.

Finally, public acceptance must be considered. This includes both the local general public and public regulatory agencies. All five alternatives can meet regulatory agency legal requirements, but some are more compatible with unofficial public goals than others. The irrigation options involve public health questions that concern both state and county health departments, and soil and crop damage questions that concern the agricultural community. There is, however, strong public support for beneficial reuse of the wastewater. State and federal law strongly support reclamation. Ocean disposal without the potential for reuse would not have this strong support. River disposal also raises public health questions that block full support from health agencies. The public health and agricultural questions could be resolved through demonstration projects prior to implementing a plan, however. Project cost may in the long run prove to be the deciding factor in public acceptance.

Recommendation

Of the six plans analyzed above (including no action), the soundest from an environmental standpoint may actually be a combination of elements from several. Regional interceptors and a central treatment plant are an acceptable framework for the system. Reuse through irrigation should also be a part of the system. Therefore, the agricultural demonstration project (see Significant Issues to be Resolved section) should be initiated as soon as possible to resolve agricultural and public health questions. Because the storage alternatives cannot be readily staged, and require large land commitments, they should not be planned as part of the initial system. Storage could be implemented as part of the other reclamation alternatives at a later date, if reclamation proves feasible and the added cost is warranted. The choice of disposal options in the interim (while the agricultural demonstration project is in progress) must be made between ocean discharge and river discharge (Alternatives 166 and 134, respectively). The ocean outfall would utilize a generally acceptable, reliable and environmentally-sound disposal method, but requires considerable capital investment. The river disposal could be beneficial to fish and wildlife resources in the Salinas River lagoon, but further analysis of river and lagoon water quality conditions is needed before the full impact of this option is known. Therefore, a decision must be reached as to whether the benefit to the lagoon is significant enough to delay a choice between ocean and river disposal and initiate a complete study of lagoon water quality.

UNAVOIDABLE ADVERSE IMPACTS

Each of the five regional alternatives would create unavoidable adverse impacts. These impacts have been described on preceding pages, and mitigation measures capable of reducing the magnitude of the impacts have been suggested where appropriate. The following table summarizes the direct and indirect unavoidable adverse impacts of construction and operation of the five systems.

Summary of Unavoidable Adverse Impacts

	Alternatives				
Impact	1	134	166	170	171
CONSTRUCTION					
Creation of local noise, dust and aerial emissions along interceptors and at plant site	x	x	x	x	x
Visual disruption at construction sites	x	x	x	x	x
Loss of vegetation and wildlife habitat to new facilities	x	x	x	x	x
Loss of non-mobile wildlife species on construction sites	x	x	x	x	x
Loss of agricultural land to new facilities	x	x	x	x	x
Temporary sedimentation in lower Salinas River or Salinas River lagoon		x	x	x	x
Temporary sedimentation in ocean waters	x		x		
OPERATION					
Slow accumulation of certain trace elements in agricultural soils		x	x	x	x
Increased salt leaching requirements in some agricultural areas		x	x	x	x
Decrease in the quality of irrigation return flows in some agricultural areas		x	x	x	x
Creation of a potential public health hazard at point of effluent discharge/reuse	x	x	x	x	x
Local increase in vector populations at wastewater storage/percolation areas		x	x	x	x
Increase in energy and chemicals required for wastewater collection, treatment and disposal	x	x	x	x	x
Increase in the volume of sewage sludge produced through wastewater treatment	x	x	x	x	x
Increase in the cost of providing wastewater treatment service	x	x	x	x	x
Fails to utilize reuse potential of treated wastewater	x				

Impact	Alternatives 1	 134	 166	 170	 171
GROWTH RELATED					
Increased pressure on local water supplies	x	x	x	x	x
Conversion of open space and agricultural land to urban uses	x	x	x	x	x
Increased pressure on public services and facilities (schools, fire and police protection, solid waste disposal, etc.)	x	x	x	x	x
Increases in urban runoff and erosion, affecting water quality.	x	x	x	x	x
Increases in stationary sources and vehicle traffic with subsequent degradation of air quality.	x	x	x	x	x
Increased demands on local energy and natural resource supplies.	x	x	x	x	x

LOCAL SHORT-TERM USES OF THE ENVIRONMENT VS. MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

All of the alternative wastewater treatment and disposal systems, including no action, involve trade-offs between beneficial and adverse impacts. Selection of the best alternative is intended to result in achieving the maximum beneficial effect at the lowest possible environmental, social and monetary cost.

The major benefit sought by each of the alternatives is the alleviation of adverse public health and water quality impacts being created by existing wastewater treatment and disposal systems in the Salinas-Monterey area. Domestic wastewater discharges to the lower Salinas River, Tembladero Slough and the shallow, near-shore waters of Southern Monterey Bay are creating occasional high bacterial counts and are adding to nutrient loads that reduce the aesthetic and recreational potential of these waters. The long-term benefit of eliminating these existing problems would be realized by both residents and visitors to the area, as well as by wildlife utilizing the present effluent receiving waters. The four wastewater reclamation alternatives (134, 166, 170 and 171) also seek to prolong the productive lifetime of groundwater supplies in the lower Salinas Valley by supplying agriculture with an alternative to continued groundwater pumping. Agricultural and domestic use of groundwater in the Salinas River basin has outstripped natural replenishment to such an extent that sea water has intruded the main water supply aquifers near the coastline. The area intruded by seawater is steadily increasing, causing abandonment of some wells and deepening of other wells; and requiring irrigation with increasingly inferior quality water. A reduction in pumping could stem the landward intrusion of sea water in the 180- and 400-foot aquifers of the lower valley. Some of the wastewater constituents (sodium, boron, cadmium) could reduce the long-term productivity of the irrigated soils, however, unless remedial agricultural practices are exercised.

Each alternative requires certain trade-offs to achieve the long-term benefits sought. The major sacrifices that are common to construction and operation of each regional alternative include the permanent dedication of open space/grazing areas to use for wastewater treatment and disposal, and the reduction of surface flows in the lower Salinas River (of consequence primarily in the dry summer months). Increased demands for power, chemical products, and the area's financial resources are also necessary. The four reclamation alternatives would extend the productive lifetime of the deeper Salinas Valley groundwater aquifers (180- and 400-foot), which are the principal source of irrigation water for the valley agricultural interests. The Salinas Valley is one of the major vegetable crop production areas in the state; the added water supply would be a positive factor in insuring the continued viability of agriculture in the Castroville area. Without additional water from some outside source, farming in the coastal portion of the valley may not continue in its present form for long as salt levels may exclude production of certain salt-sensitive crops.

The increased service area populations to be supported by the regional wastewater system will permanently displace additional open space and agricultural land. Especially significant is the loss of productive agricultural land in the Salinas and Castroville areas. The loss of prime agricultural land is not mitigatible in that high quality soils are a finite resource and cannot be created in other areas by human manipulation. The added populations will also require building material and energy resource inputs in the form of dwellings, roads, space heating and cooling and a whole variety of service-oriented structures that accompany new populations. Increasing demands on the local water supply brought on by population increases will affect the long-term productivity of existing surface and groundwater resources. The projected increases in aerial pollutants associated with regional growth could further affect crop productivity in the Salinas Valley. The oxidant levels projected in the area indicate that there may be effects on overall crop productivity.

Alternatives 1 and 166 would require 13,000 to 20,000 feet of pipe material and would remove at least 6,400 linear feet of sandy bottom marine habitat in order to place an ocean outfall into operation. Construction of an outfall would allow the earliest possible elimination of existing bay and river discharges, but it could foreclose future options by wastewater reuse. Funds for a wastewater reclamation project may not be made available once an acceptable method of disposal is in operation.

Alternatives 170 and 171 would permanently remove large acreages of grazing land from production to store wastewater for irrigation reuse. The long-term land dedication would be made in exchange for providing the maximum possible benefit to the area's water-short condition.

Alternative 134 would discharge wastewater to the lower Salinas River or lagoon rather than to the ocean during non-irrigation months. This would eliminate the need for the resource commitments of an ocean outfall, but could contribute to water quality conditions that narrow the range of future recreational uses of the lower Salinas River and/or lagoon. In reality, wastewater discharges are only one of several factors adversely affecting the recreational potential of the lower Salinas River.

The long-term dedication of land areas, construction materials, numerous natural resources and considerable capital required for each of the five regional alternatives is justified at this time because current wastewater treatment systems in north Monterey County do not meet the requirements of existing and future NPDES discharge permits required by the Federal Water Pollution Control Act Amendments of 1972 and issued by the Central Coastal Regional Water Quality Control Board. Delay in implementation of a project ("no action") would result in failure to comply with the deadlines established in the FWPCA, and would continue the degradation of water quality in the Salinas River, Tembladero Slough and southern Monterey Bay created by present wastewater discharges. The adverse public health implications of the discharges would also continue.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Minor and major irreversible and irretrievable commitments of both renewable and non-renewable resources will occur if any of the proposed projects are implemented. Construction will irretrievably commit mineral resources in the form of aggregate; pipe, treatment plant structures; excavated, displaced and submerged soils and vegetation; and petroleum fuel sources. A considerable amount of man-hours and energy resources will also be required. The pipe lengths and land commitments of each alternative were presented in the Alternative Projects section. Capital commitments for construction are also listed in this section.

After a project is in operation, man-hours and chemical and energy resources will continue to be utilized. The more advanced treatment systems (Alternatives 134, 166 and 170) generally require the largest inputs of these resources. Annual chemical and energy requirements are listed in Tables 33 and 34. The land uses and land areas displaced by treatment and disposal facilities will be lost for at least the lifetime of the facilities.

The new wastewater system is designed to accommodate the growth anticipated by local government agencies. If the other necessary elements of public service infrastructure are made available (i.e. water supply, roads, electrical power, etc.), growth will probably proceed within the project service area as described in the Secondary Impacts section of this report. Open space and agricultural land on the fringes of Castroville and Salinas would be irreversibly converted to suburban subdivisions. The loss of Salinas Valley's prime agricultral land on the fringes of these two communities is of special concern. Additional open space and valuable natural land could be lost to "new town" type subdivisions north of Salinas, near Moss Landing, in the Castroville-Prunedale area or in the Monterey-Salinas corridor area. Open grassland and oak-woodland plant communities with value as grazing land, wildlife habitat, and scenic relief would be irreversibly committed to residential use if these areas are developed.

SIGNIFICANT ISSUES TO BE RESOLVED

In the process of conducting this study, several key issues have been identified that cannot be resolved with existing data or within the existing project time constraints. These issues are summarized below, and recommendations are made for their resolution.

The issue that has created the most local concern is the feasibility of reusing treated wastewater for irrigation of vegetable crops in the lower Salinas Valley. Wastewater effluents are being furrow and spray irrigated on crops at many different localities throughout California and the nation, but few if any are spray irrigating crops such as lettuce and artichokes that are sold unprocessed to the public. Local health and agricultural agencies have expressed concern over the potential public health, soil and crop damage and crop marketability problems that could develop from irrigating with wastewater. Because the magnitude of these impacts could vary with soil and crop conditions, local agricultural practices and wastewater quality, there is a reluctance to rely on the experience of similar operations existing in other parts of the country. For this reason, the MPWPCA has proposed conducting a pilot agricultural demonstration project to study the site specific effects of wastewater irrigation in the Salinas Valley.

Engineering Science, Inc. has developed a preliminary agricultural demonstration study program for federal, state and local agency consideration. A panel of technical advisors was solicited from the public and private sectors to review this proposal and suggest changes to maximize its effectiveness. This technical advisory committee will monitor the progress of the demonstration project if it is implemented. It is recommended that this study be conducted to demonstrate the feasibility of the planned irrigation project and to answer the unresolved questions of impact on public health and local soils, crops and agriculture.

There have also been numerous questions raised regarding the potential impacts a regional ocean outfall would have on Monterey Bay. There is a wealth of information available about the general physical oceanographic conditions and biological resources in the bay, and detailed studies have been conducted at specific locations within the bay. It is felt, however, that detailed oceanographic and biological data specific to the proposed outfall site are necessary to fully assess the impact of the discharge. These data are also needed to establish a baseline which could be used to note changes in local conditions should an outfall be established.

General statements have been made in this EIS regarding the potential impacts of the proposed outfall, but the detailed current pattern, density and biological data being collected by Engineering Science, Inc. are needed to more accurately predict what the impacts might be. The data now being collected should be incorporated into a final analysis of the ocean outfall prior to implementing this disposal option. The detailed pre-discharge data will also be used to compare with actual discharge monitoring data required by EPA and the SWRCB once the outfall is in use.

An additional major unresolved issue relates to water quality in the Salinas River lagoon. All of the proposed wastewater system alternatives suggest elimination of the two Salinas wastewater discharges to the lower Salinas River. These two discharges affect water quality conditions downstream in the lagoon, especially during dry season low flow conditions. In order to properly assess the impact this discharge elimination would have on the lagoon, more complete flow and water quality data are needed.

Presently, detailed Salinas River flow and water quality data are collected at the U.S.G.S. Spreckels gauging station which is located downstream from the Salinas-Alisal waste discharge but upstream from the Salinas Main discharge. There are no consistently used flow or quality monitoring stations on the river below Salinas. Blanco Drain, a major agricultural runoff drainage ditch, enters the river approximately halfway between the Salinas Main discharge and the ocean. The water quality and flow in this ditch is now being monitored on a regular basis by the Monterey County Flood Control and Water Conservation District, but little data are presently available. The river and the drainage ditch are the key influences on water quality in the lagoon, but the relationship of their individual influences is not known. In order to understand what the effect of removing the Salinas River summer flows will have on the lagoon, its present influence must be better understood.

Several important pieces of information are needed to resolve this issue. First, an accurate picture of the lagoon's current water quality and nutrient budget is needed. At least one year of data collection would be necessary to get a complete picture. Quality parameters including dissolved oxygen, chemical oxygen demand, biochemical oxygen demand, pH, salinity and temperature stratification should be measured at regular intervals; simultaneous flow measurements would be needed.

Total nutrient concentrations in both the water and bottom sediments should be determined and diurnal changes in algae recorded. In order to determine the relative inputs from outside sources, similar water quality measures should be made in the shallow groundwater adjacent to the lagoon, in the Blanco Drain, and in the Salinas River just upstream from the lagoon. With this information in hand, the impact of eliminating the Salinas discharges could be better understood. This same information would aid the analysis of a lower river waste discharge proposed in Alternative 134. In order to comply with SWRCB (1974) policy stated in their Water Quality Control Policy for the Enclosed Bays and Estuaries of California, it must be demonstrated that the Alternative 134 lower river discharge "would consistently be treated and discharged in such a manner that it would enhance the quality of receiving waters above that which would occur in the absence of the discharge." It is most difficult to determine whether or not the discharge would enhance Salinas River lagoon water quality when the dynamics of the lagoon's existing quality are not known.

Non-point source water pollution control planning (required under Section 208 of the Federal Water Pollution Control Act Amendments of 1972) has been recently initiated in the Monterey Bay region. AMBAG, the designated 208 Planning agency, has developed a work plan that includes a compilation of existing water quality conditions throughout the area. Where available data is insufficient to identify sources of pollution, more data will be collected. It is possible that the 208 study could answer the water quality questions on the lower Salinas River, but the time frame for that study does not appear to allow its consideration in the MPWPCA wastewater facilities planning.

The air quality implications of continued urban development which will be accommodated by the proposed project have raised several policy and technical issues which must be resolved before final action is taken on the proposed project. These issues revolve around questions of AQMA designations for Monterey County and procedures for mitigating the indirect impacts of the proposed project.

Monterey County could be designated by EPA as an air quality maintenance area following a recommendation for such action by ARB. The air quality analysis presented in this report supports such a designation with regard to oxidants. The situation with regard to NO_2 is much less clear. The air quality maintenance planning program in California was intended to focus on existing or anticipated air quality problems during the 1975-1985 time frame. The projections presented in this report indicate maintenance of the state 1-hour NO_2 standard throughout this period, but possible violation of the standard during the 1985-1995 period. The dominant role of the Moss Landing power plant in regard to NO_x emissions makes any attempt to accurately forecast future NO_2 levels difficult. The programs which would be initiated following any AQMA designation for Monterey County were discussed previously (see the air quality discussions in the Environmental Setting and Secondary Impacts sections).

Several interrelated technical and policy issues must be resolved before a program of mitigation measures acceptable to all involved local, state and federal agencies can be adopted. As indicated by the two development scenarios analyzed in the Secondary Impacts section of this report, the sizing of the proposed project will be a major factor in determining the extent of mitigation required. The technical issue regarding selection of an appropriate VMT forecast also has a bearing on this issue.

Current policies of the California Air Resources Board allow use of any of the following procedures for calculating the extent of mitigation which must be demonstrated through a mitigation program:

- o "Fair Share Method" - Development of measures which will produce a percentage reduction in projected emissions in the project service area equivalent to that which is required to meet air quality standards in the "project impact area" (i.e., the area for which the air quality forecast was prepared).
- o "Ton for Ton Method" - Development of specific measures for the project service area which will offset the future stationary and mobile source emissions associated with the amount of growth induced or accommodated by the proposed project.
- o Development of measures which will result in sufficient emissions reductions to indicate achievement and maintenance of the applicable ambient air quality standards.

While the evaluations performed to date have focused on the health-related federal and state ambient air quality standards, the implications of the proposed state air conservation program should also be considered. This program may result in development of air quality standards designed to protect agricultural productivity. For some pollutants, such standards may be more stringent than the current health-based standards. The possibility exists that Monterey County would be designated as an area where such crop protection standards would take precedence over the health-based standards.

A final set of unresolved air quality-related issues involves the practical matter of implementing whatever mitigation measures may be required. The Monterey Peninsula Water Pollution Control Agency has only limited authority to take direct action other than redesign of the proposed project. Any specific stationary source, land use, or transportation control measures would have to be implemented by other agencies. The activation of an air quality maintenance planning program in Monterey County would provide a formal mechanism for dealing with this issue. The Association of Monterey Bay Area Governments provides one other mechanism for addressing this issue, although means to assure implementation of the required measures are not readily apparent.

The California State Water Resources Control Board has in the past relied upon ongoing air quality maintenance planning programs to resolve the practical issues of which agencies will implement which measures. Existing SWRCB guidelines have required that affected local governmental agencies adopt resolutions of support for the ongoing AQMP program. However, no such program currently exists in Monterey County. Recent amendments to these SWRCB guidelines indicate that temporary flow limitations may in some cases be imposed on the project applicant. The legal and institutional procedures for imposing such flow restrictions on MPWPCA have yet to be fully investigated.

Several lesser issues that deserve mention relate to subsurface geologic conditions in the dunelands south of the Salinas River. Land in the vicinity of Alternative Treatment Plant Site 4 (see Figure 28) has been suggested as a possible infiltration-percolation and underground storage area. The potential impact this operation might have on groundwater supplies in the area cannot be accurately determined without a detailed geohydrologic investigation of the proposed site. In addition, it has been recommended that a subsurface geologic investigation of the Marina landfill site is needed to determine the continuity of the clay layer underlying the site. This information is needed to analyze the potential effect of sludge disposal on groundwater. If either subsurface storage of wastewater or landfilling of sludge are to be implemented in the future, qualified geohydrologists should be retained to conduct the necessary subsurface geologic investigation.

Mitigation of the fish, wildlife and vegetation impacts associated with removing the existing Salinas River discharges also includes several unresolved issues. In order to initiate a program of additional San Antonio and/or Nacimiento Reservoir releases for mitigation below Salinas, the availability of reservoir water for a release program must be determined. This will require both legal and political decisions. The volume and timing of releases needed to maintain downstream habitat would also have to be calculated. For groundwater pumping and regional plant pump-back mitigations, it would be necessary to meet with the California Department of Fish and Game to establish the most beneficial discharge point and the minimum acceptable volume of flow to maintain fisheries. If groundwater pumping were used as a mitigation flow source, it would be necessary to fully investigate the availability and quality of surface aquifer supplies near the pumping site. Potential effects on adjacent agricultural or domestic wells should also be identified. The quality and general availability of water in the supposed "900-foot aquifer" is already being investigated by Monterey County.

Finally, if treated wastewater is to be supplied to the wildlife management area near the mouth of the Salinas River for habitat enhancement, the county and state health departments must be contacted to determine the level of treatment needed to allow this reuse. The real issue at hand is whether waterfowl hunting and bird watching should be considered contact or non-contact water recreation. The California Department of Health has expressed the desire to review the specific details of the proposed use prior to making a judgement (Crook, pers. comm.).

GLOSSARY*

ACRE-FOOT	A volume of water 1 foot deep and 1 acre in area or 43,560 cubic feet (325,851 gallons).
AERATION	Bring about contact between air and a liquid by spraying the liquid in the air, bubbling air through the liquid or agitating the liquid to promote surface absorption of air.
ALCALDE	The chief administrative and judicial officer of a Spanish town.
ALGAE	Primitive plants, one or many celled, usually aquatic, and capable of converting foodstuffs to complex organic compounds by photosynthesis.
ALGAL BLOOM	Sudden increase in amount of algae which may affect the chemical and physical properties of the water.
ALLUVIAL FAN	A low, fan-shaped cone of silt, sand and gravel material transported and deposited by flowing water.
ANADROMOUS FISH	Fish which inhabit ocean or saline waters for most of their life cycle but which ascend the river of their birth to spawn.
AQUIFER	A porous, water-bearing geologic formation. Generally restricted to materials capable of yielding an appreciable supply of water.
AQUICLUDE	A geologic formation of low permeability that prevents the flow of groundwater.
AVAILABLE OXYGEN	Quantity of dissolved oxygen available for oxidation of organic matter in a water body.
AVAILABLE WATER CAPACITY	The amount of water, expressed in inches, that the soil can retain and hold available for absorption by plant roots.
BENEFICIAL USES	Existing and potential uses which are considered desirable for human activity and for protection of the natural environment. The RWQCB employs beneficial uses to determine discharge requirements to a body of water.

BENTHOS, BENTHIC	The aggregate of organisms living on or at the bottom of a body of water (benthic - occurring on or at the bottom of a body of water).
BERM	A low mound or dike of earth or other material.
BIOCHEMICAL OXIDATION	Oxidation brought about by biological activity; results in chemical combination of oxygen with organic matter.
BIOCHEMICAL OXYGEN DEMAND (BOD)	A measure of the organic matter present in a water which can be metabolized by bacteria in a given period of time, usually five days.
BRACKISH	Containing total dissolved salts upward to 1,000 ppm; slightly saline.
CARBONACEOUS OXIDATION	The process whereby living organisms in the presence of oxygen convert the organic matter contained in wastewater into a more stable or a mineral form.
CFS	Cubic feet per second, a unit of measure of the rate of liquid flow past a given point.
CHEMICAL COAGULATION	A process involving addition of chemicals to precipitate out or flocculate undesirable suspended matter in wastewater.
CHLORIDE (Cl)	A major negative ion found in water and wastewater.
CHLORINATION	The application of chlorine to water or wastewater, generally for the purpose of disinfection.
COLIFORM BACTERIA	A type of bacteria. Its ease of identification makes it readily usable as an indicator of the presence of associated, potentially harmful bacteria (measured in MPN/100 ml [most probable number per 100 milliliters], a statistical averaging method).
COLIFORM BACTERIA (FECAL)	Coliform bacteria found in the intestines of warm-blooded animals; used as an indicator of the presence of human wastes in water.
CONDUCTANCE (ELECTRICAL OR SPECIFIC)	The ability of water to conduct electricity, measured in micromhos; conductance is related directly to the amount of dissolved salts in the water.
CONNATE WATER	Salt water, presumably sea water, entrapped in deeply buried marine sedimentary rocks.

COST EFFECTIVE	A term used when comparing the relative economic, environmental and social costs of alternative plans or projects. For wastewater projects, EPA strives to promote the alternative that meets the project objective with the lowest combined economic, environmental and social cost (i.e., the most cost effective alternative).
DEMERSAL	Living or feeding on or immediately above the bottom of the sea.
DISINFECTION	The selective destruction of disease-causing organisms (viruses, bacteria) present in a waste stream.
DISSOLVED OXYGEN (DO)	The oxygen dissolved in water, expressed in milligrams per liter, parts per million or percent of saturation.
DISSOLVED SOLIDS, also TOTAL DISSOLVED SOLIDS (TDS)	Dissolved material found in water; in natural water it is mainly the sulfates, bicarbonates, and chlorides of calcium, magnesium, and sodium. Usually expressed as parts per million or milligrams per liter.
DIURNAL	Having a daily cycle.
DOMESTIC WASTEWATER	See municipal wastewater.
EFFLUENT	Wastewater or other liquid, partially or completely treated, flowing from a point source.
EIS	Environmental impact statement.
ENGINEERING CLASSIFICATION	Soil classification systems used by engineers to categorize soils on the basis of their physical properties.
EPICENTER	The part of the earth's surface directly above the focus of an earthquake.
ESTUARY	A passage in which the tide meets a river current, especially an arm of the sea at the lower end of a river.
EVAPOTRANSPIRATION	Loss of water from the soil both by evaporation and by transpiration (loss of watery vapor through leaves) from the plants growing thereon.

EURYHALINE	Able to live in waters of a wide range of salinity.
FEDERAL SECONDARY TREATMENT EFFLUENT REQUIREMENTS	Minimum effluent quality standards for secondary treatment in terms of biochemical oxygen demand, suspended solids and pH. Standards are established by EPA.
FILTRATION	The process of passing wastewater through some medium (i.e., sand, activated carbon, diatomaceous earth, etc.) to remove suspended material.
FLOODPLAIN	Belt of low flat ground bordering a stream channel that would be inundated by stream water about once a year under natural conditions.
GEOMORPHIC	Relating to the form or configuration of the earth's surface and its genetic development.
GRANITIC	Composed of a very hard, granular, igneous rock.
GROUNDWATER	Water stored or flowing in porous materials below the earth's surface. Wells and springs are fed by groundwater.
HALOPHYTE	Any of a variety of salt-tolerant plants, able to live in salty soils.
HEAVY METALS	Metals that can be precipitated by hydrogen sulfide in acid solution, for example, gold, lead, silver, mercury, bismuth, copper.
HERBICIDE	Any substance or chemical applied to kill undesirable vegetation.
HYDROGRAPH	A chart or graph plotting stream flow data.
HYDROGRAPHY	The description and study of bodies of water.
HYDROPHYTE	A plant growing in water or in soil too waterlogged for most plants to survive.
IMPERMEABLE	Not permitting passage of a liquid through its substance.
INTERCEPTOR	A main trunk pipeline that receives flow that has been collected from numerous sources.
INTERTIDAL	A coastal shore zone between extreme high and low tide marks.

IRRIGATION RETURN FLOWS	Surface and subsurface water collected in perimeter ditches after being applied to agricultural land.
ISOHYET	Lines drawn on maps connecting points of equal annual average rainfall.
ISOTHERM	Lines drawn on maps connecting points of equal temperature.
LAND CAPABILITY CLASSIFICATION	A classification system grouping soils according to their potentialities and limitations for sustained production of commonly grown crops.
LANDINGS	Fish catches, usually measured in tons per year.
LEACHING	Removal of solids from soils by percolating water; can include irrigation and drainage removal of salts and alkalis.
LONG-TERM IMPACT	Impacts that have an extended time frame of effect. These usually last the length of the project or beyond it, and are often associated with its operation.
MARINE SEDIMENTS	Accumulations of silts, sands, clays and gravels that have settled to the bottom in seawater environments.
METAMORPHIC	Igneous and sedimentary rocks that have been altered by tremendous pressures and high temperatures.
mg/l	Milligrams per liter.
MICROMHOS	Unit of electrical conductance; the omho is equal to the reciprocal of the ohm.
MITIGATION	Measures designed to reduce the intensity or extent of an impact.
MORPHOLOGY	A study of structure and form.
MPN	Most probable number; the number of organisms per unit volume that, in accordance with statistical theory, would be more likely than any other number to yield the observed test results.

MUNICIPAL (DOMESTIC) WASTEWATER	Water-borne wastes principally derived from the use of sanitary conveniences of dwellings, office buildings and industrial plants.
NITRIFICATION	The process by which ammonia present in wastewater is biologically oxidized to become nitrite; the nitrite is then oxidized by a different group of microorganisms to become nitrate. This reduces the toxicity of the effluent.
NITROGEN (N)	An element essential for plant growth; may be considered a pollutant if found in high concentrations in certain compounds.
NON-POINT SOURCES	Wasteloads which do not enter receiving waters at a commonly identifiable location, (e.g. agricultural and storm runoff).
NUTRIENTS	Any substance or ingredient which is essential to growth; in this report it refers primarily to nitrogen and phosphorous compounds.
NUTRIENT REMOVAL	The process by which nitrates and phosphates are removed from wastewater after nitrification occurs. This is normally accomplished by the action of anaerobic bacteria that convert nitrate to nitrogen gas in the presence of a carbon source (e.g., methane). Chemical precipitation after the denitrification step removes the phosphates.
100 YEAR FREQUENCY FLOOD	A flood that has a probability of being exceeded once in 100 years, on the average.
OUTFALL	The point, location, or structure where wastewater or drainage discharges from a conduit or sewer system.
PERCHED WATER	Localized body of groundwater trapped above the surrounding groundwater table by an impervious layer of material.
PERCOLATE, PERCOLATION	To filter or pass through, as water through a sand layer.
PERMEABLE	Capable of permitting liquids or gases to pass through.
PERMEABILITY	The rate at which water may pass through a soil mass or soil horizon.
PESTICIDE	Any substance or chemical applied to kill or control pests, including weeds, insects, algae and rodents.

pH	A measure of hydrogen ion concentration on a scale of 1-14; acidity decreases from pH 1 to 7, alkalinity increases from 7 to 14. Neutral water has a pH of 7, sea water is about 8 pH.
PHREATOPHYTE	A deep-rooted plant that obtains its water from the water table (zone of saturation).
PHOSPHORUS	A naturally-occurring element essential for plant growth, and which with nitrogen may stimulate algal blooms.
PHYSIOGRAPHIC	Relating to the physical geographic or landform character of an area.
PHYTOPLANKTON	Planktonic plant life.
PIEZOMETRIC SURFACE	Hydrostatic pressure level of water in an aquifer; and the level to which water would rise if relieved of overbearing pressure.
PLANKTON	Passively floating, drifting or weakly motile organisms in a body of water; usually microscopic.
ppm	Parts per million. A measurement now being replaced by mg/l. 1 ppm of any substance in water equals: 2.7 lbs. per acre-foot 0.0038 gram per gallon 0.0284 gram per cubic foot
ppt	Parts per trillion. A measurement found herein in tables describing pesticide content of water.
PREDATION	A mode of life in which food is primarily obtained by killing and consuming of animals.
PRIMARY TREATMENT	The first major treatment in a wastewater treatment works, usually sedimentation. The removal of a substantial amount of suspended matter but little or no colloidal and dissolved matter.
PROSTRATE-TYPE PLANT	A type of plant that trails along the ground rather than growing upward.
RECENT	A period in geologic time; relating to the present or post-Pleistocene geologic epoch (also referred to as Holocene).

RECLAIMED WASTEWATER	Wastewater processed for reuse.
RIPARIAN	Relating to or living or located on the bank of a natural watercourse.
SALINE, SALINITY	The relative concentration of salts in water. Sea water contains about 20,000 ppm chloride with a salinity of 35,000 ppm. Water is termed brackish if salinity ranges upward from 1,000 ppm of dissolved salts.
SECONDARY TREATMENT	The treatment of wastewater by biological methods after primary treatment by sedimentation.
SEDIMENTATION	The process of subsidence and deposition of suspended matter carried by wastewater or other liquids by gravity; usually accomplished by reducing the velocity of the liquid below the point at which it can carry suspended material.
SEPTIC	A toxic condition resulting from the spread of bacteria or their products.
SEWAGE	The spent water of a community (this term now being replaced by wastewater).
SHORT-TERM IMPACT	Impacts that have a time frame of effect that is generally less than one year; often related to construction effects.
SHRINK-SWELL POTENTIAL	The relative change in volume of soil material to be expected with changes in moisture content.
SLOUGH	A creek or waterway in a marsh or tide flat.
SLUDGE	The solids separated from wastewater during processing, or deposits on bottoms of streams or other water bodies.
SOIL ASSOCIATIONS	A group of defined taxonomic soil units occurring together in a characteristic pattern over a geographic region.
SPECIFIC CONDUCTANCE	A measure of the resistance of a solution to electrical flow; resistance decreases as content of ionized salts increases.
SUBTIDAL	Coastal zone seaward of the extreme low tide line.
SUSPENDED SOLIDS	Solids that either float on the surface of, or are in suspension in water, wastewater, or other liquids.

SYNERGISTIC	Cooperative action of discrete agents such that the total effect of their actions is greater than the sum of the effects taken independently.
TDS	See Dissolved Solids.
TERTIARY TREATMENT	Wastewater treatment beyond the secondary level; usually involves additional filtration, chemical coagulation and sedimentation.
THERMOCLINE	A layer in a thermally stratified body of water that separates in an upper, warmer, lighter, oxygen-rich zone from a lower, colder, heavier, oxygen-poor zone.
TURBIDITY	The reduction of transparency of a liquid due to the scattering and absorbing of light by suspended particulates.
UNDERSTORY	An underlying layer of low vegetation.
WASTEWATER	Spent or used water from every source; in this report it refers primarily to water that has been used in industrial processes or in the home and then discharged to a collection and treatment system.
WASTEWATER RECLAMATION	Processing of wastewater for reuse.
0/00	Parts per thousand; an indication of concentration.

* Many of the above water-related definitions were taken directly from the Central Coastal Water Quality Control Plan Report, Part II (California State Water Resources Control Board, 1975).

BIBLIOGRAPHY

References

Abbott, Donald P. and Richard Albee. 1967. Summary of thermal conditions and phytoplankton volumes measured in Monterey Bay, California 1961-66. California Cooperative Fisheries Investigation 11: 155-156.

Adams, A. M. and E. J. Schneider. 1952. [Article in] Air Pollution and Smoke Prevention Association of America, proceedings. 45: 61-63.

Adams, Kenneth. 1947. California missions. California Mission Trails Association, Ltd.

American Lung Association. 1974. Air pollution primer. 104 pp.

Applegate, H. G. and L. C. Durrant. 1969. Synergistic action of ozone-sulfur dioxide on peanuts. Environmental Science and Technology, 3(8): 759-760.

Ayers, Robert S. and Roy L. Branson. 1974. Guidelines for interpretation of water quality for agriculture. University of California, Committee of Consultants.

Baier, Dwight C., et al. 1975. Cost and effectiveness of point source pollution control options for irrigated agriculture, a report to the National Commission on Water Quality.

Baier, Dwight C. and Wilton B. Fryer. 1975. Undesirable plant responses with sewage irrigation. Journal of the Irrigation and Drainage Division ASCE, 99(1R2): 133-141. Proc. Paper 9783.

Bancroft, Hubert. 1884. History of California. A. L. Bancroft and Co., San Francisco.

Bartle Wells Associates. 1976. Financing plan and institutional program - north Monterey County regional water pollution control project.

Battelle Memorial Institute, Pacific Northwest Laboratories. 1973. Municipal sewage treatment - a comparison of alternatives. Prepared for the Council on Environmental Quality and U.S. Environmental Protection Agency.

Blumenthal, D. L. 1976. Distribution and transport of ozone in the South Coast Air Basin. California Air Environment, 6(1): 4,5,10.

Blumenthal, D. L., et al. 1974. Three dimensional pollutant gradient study: 1972-73 program. Meteorological Research, Inc. and California Air Resources Board. 349 pp.

Bolin, R. L. and D. P. Abbott. 1963. Studies on the marine climate and phytoplankton of the central coastal area of California 1954-1960. California Cooperative Fisheries Investigation 9: 23-45.

Boundaries and Forecasting Committee, South Coast/Southeast Desert Air Quality Maintenance Planning Policy Task Force. 1976. Preliminary emissions inventory and air quality forecast, 1974-1995. Final report and appendix. 118 pp. + 199 pp.

Brown & Caldwell, Consulting Engineers. 1971. Marine waste disposal; final report to the City of San Francisco.

Browning, Bruce M. et al. 1972. The natural resources of Elkhorn Slough, their present and future use. California Department of Fish and Game.

Burkland and Associates. 1975. Geotechnical study for the seismic safety element, Monterey County, California.

California. Air Resources Board. 1970-1975. California air quality data. Vol. II, no. 2 through Vol. VII, no. 4.

----------. 1972. The state of California implementation plan for achieving and maintaining the national ambient air quality standards.

----------. 1973a. A report to the Legislature on guidelines for relating air pollution control to land use and transportatio planning in the state of California. 145 pp.

----------. 1973b. Average motor vehicle emission factors in grams per mile, based on 7-mode cold start test cycle.

----------. 1973c. California air quality data. Vol. V, nos. 1-4.

----------. 1974-1975. California air quality data supplement for environmental impact assessments. Vol. I & II.

----------. 1974a. Air pollution in California. 1973 annual report. 44 pp.

----------. 1974b. California air quality data. Vol. VI, nos. 2-3.

----------. 1974c. Emissions forecasting methodologies. 45 pp. + appendices.

----------. 1974d. Introduction to manual methods for estimating air quality. 34 pp. + appendices.

----------. 1974e. Ten year summary of California air quality data, 1963-1972. 211 pp.

----------. 1974f. The State of California implementation plan for achieving and maintaining the national ambient air quality standards, revision 5.

----------. 1975a. Air pollution in California: 1974 annual report.

----------. 1975b. County air pollution control law; Bay Area air pollution control law; regional air pollution control law. For use in 1975.

----------. 1975c. Miscellaneous laws relating to air pollution control. For use in 1975.

----------. 1975d. Mulford-Carrell Act, part 1. For use in 1975.

----------. 1976a. Ambient air quality standards.

----------. 1976b. Emissions and air quality assessment.

----------. 1976c. Emission inventory, 1973.

----------. 1976d. Plan development program for an air conservation program for California. 22 pp.

California. Business and Transportation Agency. 1975. California transportation plan, vol. 1 & 2.

California Coastal Zone Conservation Commission. 1975. California coastal plan. 443 pp.

California. Department of Finance. 1974. Population projections for California counties 1975-2000. Alternative series D-100, E-O, D-150, C-150. Report 74P-2. 23 pp.

----------. 1975a. Population estimates for California cities and counties, January 1, 1974 and January 1, 1975. Report 75E-1. 8 pp.

California. Department of Fish and Game. 1949. The commercial fish catch of California for the year 1947 with a historical review 1916-1947. Fish Bulletin 74.

----------. 1964. The California marine fish catch for 1962. Fish Bulletin 125.

----------. 1965. California fish and wildlife plan, vol. III supporting data, part A - inventory wildlife and inland fish.

----------. 1970. The California marine fish catch for 1968 and historical review 1916-1968. Fish Bulletin 149.

----------. 1973. California marine fish landings for 1971. Fish Bulletin 159.

----------. 1974. At the crossroads - a report on California's endangered and rare fish and wildlife, second edition. 112 pp.

California. Department of Health. 1974. Guidelines for use of reclaimed water for spray irrigation of crops; guidelines for use of reclaimed water for surface irrigation of crops; and guidelines for worker protection at water reclamation use areas.

----------. 1976. A report to the 1976 legislature on health effects of air pollution, pursuant to Assembly Concurrent Resolution no. 45, 1975.

California. Department of Public Health. 1971. Sanitary engineering investigation of Salinas River reclamation ditch and Blanco Drain, Monterey County.

California. Department of Transportation. 1975a. 1974 inventory update, average daily traffic volume trends.

----------. 1975b. Forecast of 1995 traffic volumes.

----------. 1976. Monterey County transportation plan. 105 pp. + appendices.

California. Department of Water Resources. 1965. Water quality conditions, lower Salinas River, Monterey County, California. Report 4103-024.

----------. 1973. Hydrologic data: 1972, vol. III - central coastal area. Bulletin 130-72.

----------. 1973a. Sea water intrusion, lower Salinas Valley, Monterey County.

----------. 1974. Hydrologic data: 1973, vol. III - central coastal area. Bulletin 130-73.

California. Division of Mines & Geology. 1959. Geologic map of California, Santa Cruz sheet.

California. Employment Development Department. [n.d.] Wage and salary workers in non-agricultural establishments, by industry: Salinas-Seaside-Monterey metropolitan statistical area. Parts A and B.

----------. 1975. Area manpower review. Salinas-Seaside-Monterey standard metropolitan statistical area.

California Energy Resources Conservation and Development Commission. 1976. Staff proposed electricity forecasting and planning report. Vol. II.

California Native Plant Society. 1974. Inventory of rare and endangered vascular plants of California. 56 pp.

California Natural Areas Coordinating Council. 1975. Inventory of California natural areas, vol. III.

California. Public Utilities Commission. 1976. Draft EIR, California-American Water Company Canada de la Segunda pipeline and Begonia Iron Removal Plant.

California. Regional Water Quality Control Board, Central Coast Region. 1974. Water quality control plan, central coastal basin (3), part 1.

----------. 1974a. Water quality control plan, central coastal basin (3), part 1 revised.

California. State Office of Planning and Research. 1973. Prime and potential agricultural lands map; 1:250,000 - Santa Cruz sheet; prepared by the California Department of Water Resources.

California. State Water Resources Control Board. 1972. Water quality control plan - ocean waters of California. 13 pp.

----------. 1974. Effects of energy shortage on the treatment of wastewater in California.

----------. 1974a. Revenue program guidelines for wastewater agencies.

----------. 1975. Water quality control plan, central coastal basin (3), part 1.

----------. 1975a. Water quality control plan report - central coastal basin (3), part 1.

----------. 1976. Division of Water Quality procedure for minimizing air quality impacts of projects in critical air areas.

----------. 1976a. SWRCB internal memo 415:GB - Monterey project service area, Monterey County population projections proposed by George Billingsley.

----------. 1977. Guidelines for considering air quality in environmental impact reports and environmental impact statements for Clean Water Grant Projects. Clean Water Grant Bulletin no. 47.

Carter, Charles. 1900. The missions of Nueva California. Whitaker and Ray Company, San Francisco.

Chapman, Charles. 1928. A history of California: the Spanish period. The Macmillan Company, New York.

Chartock, Michael A. 1969. Preliminary efforts at a quantification of the benthos between the five and ten fathom contours at the head of the Monterey submarine canyon, California. M.A. Thesis, San Jose State College.

Cleland, Robert. 1929. Pathfinders. Powell Publishing Company, San Francisco.

Corn, Morton. 1976. Aerosols and the primary air pollutants - nonviable particles; their occurrence, properties and effects. In: Air Pollution, third edition, A. C. Stern (ed). pp. 78-168.

Council of Monterey Bay, Inc. 1974. 1973 statistical review of all cities and unincorporated areas. 18 pp.

Del Monte Properties Company. [n.d.] The seventeen mile drive.

Denis, Alberta. 1927. Spanish Alta California. The Macmillan Company, New York.

Detwyler, Thomas R. 1972. Vegetation in the city. In: Urbanization and environment, T. R. Detwyler and M. Marcus, ed., pp. 229-259.

Detwyler, Thomas R. and Melvin Marcus, (ed). 1972. Urbanization and environment. Duxbury Press, Belmont, California. 287 pp.

Dolchinger, L. S. and T. A. Seliga (ed). 1976. Proceedings of the first international symposium on acid precipitation and the forest ecosystem. U. S. Forest Service general technical report NE-23. 1,074 pp.

Drewry, W. A. and R. Eliassen. 1968. Virus movement in groundwater. Journal Water Pollution Control Federation, 40: 257-271.

Ekdahl, Carl and Charles D. Keeling. 1973. Atmospheric carbon dioxide and radiocarbon in the natural carbon cycle: I. Quantitative deductions from records at Mauna Loa Observatory and at the South Pole. In: Carbon in the biosphere, G. M. Woodwell and E. V. Pecan, ed. pp. 51-85.

Elstob, Winston. 1965. Chinatown: a legend of old Cannery Row. Condors Sky Press, Orinda, California.

Engelhardt, Charles. 1912. The missions and missionaries of California. James H. Barry Company, San Francisco.

Environmental Science and Technology. 1970. Air pollution: plant killer, 4(8): 635-636.

Engineering Science, Inc. 1975. Facilities plan for north Monterey County; interim report no. 1, basis of planning report. Prepared for Monterey Peninsula Water Pollution Control Agency.

----------. 1975a. Oceanographic investigations in Monterey Bay. Prepared for Monterey Peninsula Water Pollution Control Agency.

----------. 1975b. Facilities plan for north Monterey County working paper; screening of alternatives; dated August, 1975. Prepared for Monterey Peninsula Water Pollution Control Agency. 14 pp. + appendices.

----------. 1975c. Facilities plan for north Monterey County working paper; evaluation of selected alternatives; dated December, 1975. Prepared for Monterey Peninsula Water Pollution Control Agency. 35 pp.

----------. 1975d. Facilities plan for north Monterey County - alternative courses of action (June). 15 pp.

----------. 1975e. Facilities plan for north Monterey County - apparent best alternatives (October). 6 pp.

----------. 1976. Facilities plan for north Monterey County working paper; treatment plant sites and interceptor alignments; dated February, 1976. Prepared for Monterey Peninsula Water Pollution Control Agency in cooperation with Jones & Stokes Associates, Inc. 22 pp.

----------. 1976a. Facilities plan for north Monterey County working paper; design populations and dry weather wastewater flows; dated January, 1976. Prepared for Monterey Peninsula Water Pollution Control Agency. 8 pp.

----------. 1976b. Facilities plan for north Monterey County working paper; preliminary design of wastewater facilities; dated March, 1976. Prepared for Monterey Peninsula Water Pollution Control Agency. 11 pp. + appendices.

----------. 1976c. Facilities plan for north Monterey County - proposed agricultural irrigation demonstration program. 9 pp. + appendices.

----------. 1976d. Facilities plan for north Monterey County, interim report no. 3 - draft facilities plan report.

----------. 1976e. Oceanographic investigations in central Monterey Bay - survey activities January-April 1976.

----------. 1976f. Facilities plan for north Monterey County, interim report no. 4, draft oceanographic predesign report, volume 1.

Faith, W. L. and A. A. Atkisson, Jr. 1972. Air pollution. Second edition. Wiley-Interscience, N. Y. 393 pp.

Federal Register. 1974. Tuesday February 19, 1974, vol. 39, no. 34, part II.

Fink, Augusta. 1972. Monterey. Chronicle Books, San Francisco.

Ford, O. N. 1975. Monterey Peninsula Airport District, letter of September 23, 1975 to Gruen Gruen + Associates regarding current and future operations at Monterey Peninsula Airport.

Ford, Tirey. 1926. Dawn and the Dons. A. M. Robertson, San Francisco.

Garcia, A. W. and J. R. Houston. 1975. Technical report H-75-17; Type 16 flood insurance study: tsunami predictions for Monterey and San Francisco Bays and Puget Sound; Hydraulics Laboratory, U. S. Army Corps of Engineers Waterways Experiment Station.

Goldberg, E. D. et al. 1971. Marine chemistry. In: Radioactivity in the marine environment. National Academy of Science, Allen H. Seymour (ed).

Gordon, Burton L. 1974. Monterey Bay area: natural history and cultural imprints. The Boxwood Press, Pacific Grove, California. 202 pp.

Greene, Gary H. 1970. Geology of southern Monterey Bay and its relationship to the groundwater basin and salt water intrusion. U. S. Geological Survey Open File Report.

----------. 1973. Faults and earthquakes in the Monterey Bay region, California. U. S. Geological Survey.

Gruen Gruen + Associates. 1973. Economic evaluation of tri-county coastline study. 43 pp.

----------. 1973. Economic evaluation of tri-county coastline study land use policies: phase II analysis. 13 pp.

----------. 1975. Letter of September 17, 1975 to Jones & Stokes Associates regarding airport operation in Monterey County.

Haagen-Smit, A. J. and L. G. Wayne. 1976. Atmospheric reactions and scavenging processes. In: Air pollution, third edition, A. C. Stern, ed. pp. 235-288.

Hanna, Steven. 1971. A simple method for calculating dispersion from urban area sources. Journal of the Air Pollution Control Association, 21(12): 774-777.

Heagle, Allen S. 1973. Interaction between air pollutants and plant parasites. Annual Review of Phytopathology, 11: 365-388.

Heath, Robert L. 1975. Ozone. In: Responses of plants to air pollution, J. B. Mudd and T. T. Kozlowski, ed. pp. 23-55.

Hecht, T. A. 1973. [Contribution to] U.S. EPA, workshop on mathematical modeling of photochemical smog: summary of the proceedings. EPA document no. R4-73-010.

Hindawi, I. J. 1970. Air pollution injury to vegetation. National Air Pollution Control Administration publ. AP-71.

Hoover, Mildred, Hero E. Rensch, Ethel G. Rensch. 1970. Historic spots in California, third edition. Stanford University Press.

Horsman, D. C. and A. R. Wellburn. 1976. Appendix II, guide to the metabolic and biochemical effects of air pollutants on higher plants. In: Effects of air pollutants on plants, T. A. Mansfield, ed., pp. 185-199.

Jennings, Charles W. and Rudolph G. Strand. 1959. Geologic map of California, Santa Cruz sheet, 1:250,000. California Division of Mines & Geology.

Jones & Stokes Associates, Inc. 1975. Draft environmental impact report - Chino Basin Municipal Water District regional plant no. 1 facilities plan. 353 pp.

----------. 1976. Draft report - assessment of effects of altered streamflows on fish and wildlife in California - task II - individual case study results and evaluation. Prepared for the U. S. Fish and Wildlife Service.

----------. 1976a. Environmental data statement - Canada de la Segunda pipeline and Begonia iron removal plant; prepared for the California-American Water Company. 238 pp.

----------. 1976b. Draft EIR - Moss Landing facilities plan. Prepared for the Monterey Peninsula Water Pollution Control Agency.

Kauper, E. K. and B. L. Niemann. 1975. Los Angeles to Ventura over water ozone transport study. Final report, vol. I, technical report. Metro Monitoring Services and California Air Resources Board. 51 pp.

Koebig & Koebig, Inc. and Hahn, Wise & Associates, Inc. 1973. Moss Landing area development plan. 46 pp.

Kroeber, A. L. 1925. Handbook of California Indians. Bureau of American Ethnology, Bulletin 78.

Landsberg, H. E. 1970. Climates and urban planning. In: World meteorological organization, urban climates. Geneva, Switzerland, pp. 364-374.

John V. Lowney & Associates. 1976. Reconnaissance geotechnical study regional facilities treatment and distribution plan, Monterey County, California.

MacGinitie, G. E. 1935. Ecological aspects of a California marine estuary. American Midland Naturalist, 16: 629-765.

McKee, J. E. and H. W. Wolf. 1971. Water quality criteria. California State Water Resources Control Board publ. 3-A.

Mansfield, T. A. (ed.). 1976. Effects of air pollutants on plants. Society for Experimental Biology, Seminar Series No. 1. Cambridge University Press, London. 209 pp.

Marcin, Thomas C. 1974. The effects of declining population growth on the demand for housing. U. S. Forest Service. 12 pp.

Massachusetts Institute of Technology. 1971. Inadvertent climate modification. Report of the study on man's impact on climate. 308 pp.

Merrill, R. J. and E. S. Hobson. 1970. Field observations of Dendraster excentricus, a sand dollar of western North America. American Midland Naturalist, 83: 595-624.

Metcalf & Eddy Engineers. 1975. Draft report - land application of wastewater in the Salinas-Monterey Bay area. Prepared for the U. S. Army Corps of Engineers, San Francisco District.

----------. 1976. Report - land application of wastewater in the Salinas-Monterey Peninsula area. Prepared for the U. S. Army Corps of Engineers.

Millecan, Arthur A. 1976. A survey and assessment of air pollution damage to California vegetation, 1970 through 1974. California Dept. of Food and Agriculture. 48 pp.

Monterey Bay Unified Air Pollution Control District. 1975. 1974 annual report. 34 pp.

Monterey. City Planning Department. 1974. Statistical summary: social and economic data, City of Monterey. 21 pp.

----------. 1975. Technical report: Monterey II: a plan for the Highway 68 area to the year 2000. (1-8).

Monterey County. 1970. Residential subdivision water supply standards. 22 pp.

----------. 1970. Standard details. 29 pp.

----------. 1972. Monterey County scenic highway plan, Highway 156.

----------. 1974. Ordinance no. 1713 subdivision ordinance. 35 pp.

----------. 1975. Guidelines: objectives, criteria and procedures pursuant to the Environmental Quality Act of 1970. 28 pp.

Monterey County. Auditor-Controller. 1960, 1966, 1970, 1974-1976. Tax rates and information for taxpayers.

Monterey County. Board of Supervisors. 1968. Monterey County general plan. 13 pp.

Monterey County. Department of Agriculture. 1950-54, 1956, 1959, 1961, 1963, 1965, 1967, 1974. Annual crop reports.

Monterey County Flood Control and Water Conservation District. [n.d.] Groundwater and climatology for water year October 1, 1970 to September 30, 1971. 75 pp.

----------. [n.d.] Hydrology - surface water, rainfall, streamflow for water year October 1, 1969 to September 30, 1970. 68 pp.

----------. 1976. Map of contours of chloride, pressure aquifers, summer 1975.

Monterey County Health Department, Santa Cruz County Health Department, State Department of Public Health and Central Coastal Regional Water Quality Control Board. 1970. A study of the bacteriological quality of Monterey and Carmel Bays - April 1, 1969 through May, 1970. 97 pp. + appendices.

Monterey County. Planning Commission. 1967. Marina master plan.

----------. 1972. The open space element.

----------. 1975. Sections 28.3 through 28.5 of ordinance no. 1615, July 1968.

Monterey County. Planning Department. 1970. Monterey County - current population and housing - 1970. 6 pp.

----------. 1973. Castroville general plan. 49 pp.

----------. 1973. Monterey County facts and figures. 4 pp.

Monterey County Transportation Study. (Formerly Salinas-Monterey Area Transportation Study - SMATS). 1972. Origin and destination survey, 1970. 147 pp.

----------. 1973. Public transportation inventory update 1973.

----------. 1973a. Forecast year report 1973. 54 pp.

----------. 1974. 1974 land use inventory. 16 pp.

----------. 1975. 1975 housing and population inventory. 26 pp.

----------. 1975a. 1974 annual report. 33 pp.

Monterey County Transportation Study. 1975. 1974 daily vehicle miles of travel. 3 pp.

Monterey Peninsula Water Pollution Control Agency. 1973. Population projections by planning area.

Monterey-Santa Cruz County Unified Air Pollution Control District. 1972-1974. 1971-1973 annual reports.

James M. Montgomery, Consulting Engineers, Inc. 1975. Chino Basin Municipal Water District - prototype plant study.

Morgester, James J. 1969. California Department of Water Resources office report - water quality of the lower portion, Salinas groundwater basin.

Mudd, J. B. and T. T. Kozlowski (ed). 1975. Responses of plants to air pollution. Academic Press, Inc. New York. 383 pp.

Munson, Edward W. 1976. Solid waste management plan - County of Monterey. Monterey County Planning Department.

Munz, P. A. 1968. Supplement to a California flora. University of California Press, Berkeley. 198 pp.

Munz, P. A. and D. Keck. 1959. A California flora. University of California Press, Berkeley. 1681 pp.

National Academy of Sciences. 1972. Water quality criteria. 339 pp.

----------. 1973. Conference on health effects of air pollution, summary of proceedings. October 3-5, 1973. Prepared for the Committee on Public Works, U.S. Senate, serial no. 93-13.

National Academy of Sciences and National Academy of Engineering. 1975. Air quality and stationary source emission control. U.S. Senate Subcommittee on Public Works, serial no. 94-4. 909 pp.

Nobile, P. and J. Deedy (ed.). 1972. The complete ecology fact book. Doubleday & Co., N. Y. 472 pp.

North Salinas/Santa Rita Citizen's Advisory Committee. 1973. Salinas: general plan program interim development policies. 14 pp.

Northern Salinas Valley Mosquito Abatement District. 1975. Water quality monitoring of aquatic sources in northern Salinas Valley relative to vector production and other aquatic nuisance potentials. Data sheet provided by Mr. C. Donald Grant.

Nybakken, J. W., et al. 1975. A baseline study of the Moss Landing/Elkhorn Slough environment - progress report; prepared by the Moss Landing Marine Laboratories for Pacific Gas & Electric Co. 219 pp.

Oceanographic Services, Inc. 1973. AMBAG oceanographic survey (draft copy).

Pacific Grove. City Planning Department. 1973. The general plan of the City of Pacific Grove. 82 pp.

Paskind, Jack and John R. Kinosian. 1974. Hydrocarbons, oxides of nitrogen and oxidant pollutant relationships in the atmosphere over California cities. California Air Resources Board paper #74-31. 20 pp.

Pirie, Douglas M. and Michael J. Murphy. 1975. California coastal processes study - aircraft project X-098 final report. Prepared by the U. S. Army Corps of Engineers for the National Aeronautics and Space Administration.

Pitts, James N., et al. 1975. Chemical consequences of air quality standards and of control implementation programs: roles of hydrocarbons, oxides of nitrogen and aged smog in the production of photochemical oxidants. Statewide Air Pollution Research Center, University of California, Riverside.

Planning Environment International. 1976. Preliminary evaluation of alternative tactics and strategies for the South Coast/Southeast Desert Air Quality Maintenance Plan. Prepared for the California Air Resources Board and the Tactics and Strategies Committee, South Coast AQMP Policy Task Force. 69 pp. + appendices.

Pound, Charles E. and Ronald W. Crites. 1973. Wastewater treatment and reuse by land application. Volume I - summary. U. S. EPA Environmental Protection Technology Series. 81 pp.

Powers, Laura. 1934. Old Monterey. San Carlos Press, San Francisco.

Public Information Office. U.S. Army Training Center, Infantry. 1974. News release. 8 pp.

Richard Raymond Associates. 1969. An economic analysis of the Monterey area. 48 pp.

Reinert, R. A., A. S. Heagle, W. W. Heck. 1975. Plant responses to pollutant combinations. In: Responses of plants to air pollution, J. B. Mudd and T. T. Kozlowski, ed., pp. 159-177.

Robinson, E. R. and R. C. Robbins. 1972. Emissions, concentrations and fate of gaseous atmospheric pollutants. In; Air pollution control, part II, W. Strauss, ed., pp. 1-93.

Salinas Chamber of Commerce. 1974. Economic Council report. 8 pp.

----------. 1975. Community economic profile. 4 pp.

Salinas. City Public Works Department. 1975. Population projections, Salinas area. 3 pp.

San Diego Air Quality Planning Team. 1975. Regional air quality strategies for the San Diego Air Basin. 124 pp.

Sander, Stanley P. and John H. Seinfeld. 1976. Chemical kinetics of homogeneous atmospheric oxidation of sulfur dioxide. Environmental Science and Technology, 10(12): 1114-1123.

Sepp, Endel. 1972. Guidelines for sewage disposal by hillside sprays. State Department of Public Health, Bureau of Sanitary Engineering. 20 pp.

Simmons, William and Robert H. Cuthing, Jr. 1974. A many layered wonder: non-vehicular air pollution control law in California. The Hastings Law Journal, 26(1): 109-166.

Skogsberg, Tage. 1936. Hydrography of Monterey Bay, California: thermal condition, 1929-1936. Transactions American Philos. Society, 29: 1-152.

Southern California Coastal Water Research Project. 1973. The ecology of the Southern California bight: implications for water quality management.

Stanford Research Institute. 1958. The uses of meteorological data in large scale air pollution surveys. Prepared for the California State Dept. of Public Health. 110 pp.

Stern, Arthur C. (ed). 1976. Air pollution, third edition. Vol. I. - Air pollutants, their transformation and transport. Academic Press, Inc. New York. 715 pp.

Strauss, W. (ed). 1972. Air pollution control - part II. Wiley-Interscience, New York.

Taylor, O. C., et al. 1973, 1974. Oxidant air pollution effects on a western coniferous forest ecosystem. Task B report (1973) and task D report (1974). Statewide Air Pollution Research Center, University of California, Riverside.

Taylor, O. C., C. R. Thompson, D. T. Tingey, R. A. Reinert. 1975. Oxides of nitrogen. In: Responses of plants to air pollution, J. B. Mudd and T. T. Kozlowski, ed., pp. 121-139.

Tingey, D. T., R. A. Reinert, J. A. Dunning, W. W. Heck. 1971. Vegetation injury from the interaction of nitrogen dioxide and sulfur dioxide mixtures. Phytopathology, 61: 1506-1511.

----------. 1973. Foliar injury response of eleven atmospheric plant species to ozone/sulfur dioxide mixtures. Environment, 7(2): 201-208.

Treshow, Michael. 1975. Interactions of air pollutants and plant disease. In: Responses of plants to air pollution, J. B. Mudd and T. T. Kozlowski, ed., pp. 307-334.

----------. 1973. Foliar injury response of eleven atmospheric plant species to ozone/sulfur dioxide mixtures. Environment, 7(2).

Trechow, Michael. 1975. Interactions of air pollutants and plant disease. In: Responses of plants to air pollution, J. B. Mudd and T. T. Kozlowski, ed. pp. 307-334.

U. S. Bureau of Reclamation. 1974. Public Law 984 loan application report in support of the proposed Castroville irrigation project. Prepared by Monterey County Surveyors, Inc. and Koretsky King Associates, Inc.

U. S. Bureau of the Census. 1940 through 1970. Decennial census of housing and population.

----------. 1974. Population of the United States, trends and prospects: 1950-1990. Current Population Reports, Series P-23, no. 49.

U. S. Congress. 1967. Air quality act of 1967, public law 90-148.

----------. 1970. Clean air act amendments of 1970, public law 91-604.

----------. 1970-1975. Environmental quality - the annual reports of the Council on Environmental Quality.

U. S. Council on Environmental Quality and Federal Council for Science and Technology. 1975. Fluorocarbons and the environment. Report of the Federal Task Force on Inadvertent Modification of the Stratosphere. 109 pp.

U. S. Department of Agriculture. 1954. Diagnosis and improvement of saline and alkali soils. Handbook 60. Salinity Laboratory, Riverside, California.

U. S. Department of Commerce. 1974. OBERS projections: economic activity in the United States.

U. S. Department of Health, Education and Welfare. 1969. Air quality criteria for particulate matter. AP-49.

----------. 1970a. Air quality criteria for carbon monoxide. AP-62.

----------. 1970b. Air quality criteria for hydrocarbons. AP-64.

----------. 1970c. Air quality criteria for photochemical oxidants. AP-63.

----------. 1970d. Air quality criteria for sulfur oxides. AP-50.

----------. 1971. Air quality criteria for nitrogen oxides. AP-84.

U. S. Department of Interior. 1974. United States list of endangered fauna. Prepared by the U. S. Fish and Wildlife Service. 22 pp.

U. S. Environmental Protection Agency. 1971. Noise from construction equipment and operations, building equipment and home appliances. 188 pp.

----------. 1971. Noise from construction equipment and operations, building equipment and home appliances. 188 pp.

----------. 1971a. Noise from industrial plants. Prepared by L. S. Goodfriend Associates. 302 pp.

----------. 1973. Proposed criteria for water quality, volume 1. 425 pp.

----------. 1974. Guidelines for air quality maintenance planning and analysis. Vol. 3: control strategies.

----------. 1975. Water programs - national interim primary drinking water regulations. Federal Register, December 24, 1975, vol. 40, no. 248.

----------. 1976. Compilation of air pollutant emission factors, second edition and supplements 1-5, publication AP-42, parts A & B.

U. S. Fish and Wildlife Service. 1973. Threatened wildlife of the United States. Resources Publication 114. 289 pp.

----------. 1976. Methodologies for the determination of stream resource flow requirements: an assessment.

U. S. Geological Survey. 1972. Reconnaissance study of selected nutrients, pesticides and trace elements in the Eel, Salinas and Santa Ana Rivers, California October 1971 through July 1972. Water Resources Investigation 16-73.

----------. 1966-1975. Water resources data for California, part 1 - surface water records, volume 1.

U. S. Soil Conservation Service. 1968. Report and general soil map, Monterey County, California.

----------. 1975. Soil Survey of Monterey County, California. An interim, unedited report.

University of California, Davis. Department of Soils and Plant Nutrition. 1973. Chemical analyses of soil samples from the Salinas Valley, California for cadmium, zinc, phosphate, a report to the California State Water Resources Control Board, July 1973.

Urone, Paul. 1976. The primary air pollutants - gaseous, their occurrence, sources and effects. In: Air pollution, third edition, A. C. Stern, ed. pp. 24-75.

Alan M. Voorhees & Associates, Inc. 1975. Monterey County transportation plan final EIR. Prepared for the Monterey County Transportation Commission.

----------. 1975a. Monterey County transportation plan. 64 pp.

Water Resources Engineers, Inc. 1969. Evaluation of alternative water quality control plans for Elkhorn Slough and Moss Landing Harbor.

Whelpdale, D. M. and R. E. Munn. 1976. Global sources, sinks and transport of air pollutants. In: Air pollution, third edition, A. C. Stern, ed. pp. 290-324.

White, K. L. et al. 1974. Synergistic inhibition of apparent photosynthesis rate of alfalfa by combinations of sulfur dioxide and nitrogen dioxide. Environmental Science and Technology, 8(6): 574-576.

Wilcox, L. V. 1966. U. S. Salinity Laboratory mimeo, December 30, 1966.

Willix, R. 1976. "Appendix I - An introduction to the chemistry of atmospheric pollutants. In: Effects of air pollutants on plants, T. A. Mansfield, ed., pp. 161-184.

Winkler, Erhard M. 1976. Natural dust and acid rain. In: Dochinger and Seliga (ed), pp. 209-217.

Woodward, G. M. and E. V. Pecan(ed). 1973. Carbon in the biosphere. Proceedings of the 24th Brookhaven symposium in biology. U. S. Atomic Energy Commission. 392 pp.

Wright, Agnes. 1931. The beginnings of Monterey. Master's thesis, University of California, Berkeley.

Yoder-Trotter-Orlob and Associates. 1971. Task II-1, develop population and land use projections; preliminary report. 9 pp.

----------. 1973. AMBAG water quality management plan.

Zeldin, Melvin D. 1973. Oxidant distribution and analysis in the San Bernardino Air Basin, San Bernardino Air Pollution Control District. 25 pp.

Personal Communications

Abercrombie, J. A. 1975. Monterey-Santa Cruz County Unified Air Pollution Control District - National Weather Service data dated May 29, 1975.

Agid, Gary. September 10, 1975. California Air Resources Board.

Albert, Tom. March 1976. Monterey Peninsula Rapid Transit.

Arnoldy, Jim. October 30, 1975. California Air Resources Board.

Ayers, Robert S. March 16, 1976. Extension Soils and Water Specialist, University of Calfiornia, Davis.

Bakeman, Melvin. January 1976. Monterey County Planning Department.

Baldridge, Robert. 1976. Data sheet dated November 19, 1975. Central Coastal Regional Water Quality Control Board.

Bayless, Hugh. March 1976. City of Carmel.

Billingsley, George. September 1975. State Water Resources Control Board.

Binder, R. L. 1976. Letter dated January 9, 1976. Monterey County Flood Control and Water Conservation District.

Bradley, Richard. February 3, 1977. California Air Resources Board.

Bratcher, Dick. California State Water Resources Control Board.

Briggs, Roger. 1976. California Regional Water Quality Control Board, Central Coastal Region.

Brooks, Sidney. January 1976. Monterey Peninsula Water Pollution Control Agency.

Browning, Bruce. California Department of Fish and Game, Coastal Wetlands Program, Sacramento.

Brucker, Mark. October 6, November 13, 1975. U. S. Environmental Protection Agency.

Burris, William. 1975. Planning Director, City of Seaside, California.

California Department of Fish and Game. 1975. Unpublished species list from Monterey office files.

California Department of Water Resources. 1975. Water quality analysis sheets received from Scott Nevins, DWR Fresno office, September 22, 1975.

California Regional Water Quality Control Board, Central Coastal Region. 1976. Kaiser Refractories annual discharge monitoring report, 1973.

California State Water Resources Control Board. 1976. Data sheets supplied by Larry Pearson, March 30, 1976.

Campbell, S. Kent. 1976. May 1976 letter from the Monterey Bay Unified Air Pollution Control District listing wind conditions on days of high oxidant levels in Monterey Bay region.

Carlson, John. 1975-76. Planning staff, City of Seaside, January 1976 and August 1975.

Case, H. March 1976. California Department of Transportation, District 5, San Luis Obispo.

Colburn, Larry. 1976. City of Pacific Grove, November 1976.

Cole, T. G. Engineering Science, Inc.

Cook, Jeff. January 20, 1977. California Air Resources Board.

Crites, Ron. February 1976. Metcalf & Eddy, Engineers.

Crook, James. November 1976. California Department of Health, Water Sanitation Division.

Dado, Dudley. March 1976. Southern Pacific Railroad.

Davis, John. Engineering Science, Inc.

Davis, Stanley. September 1975. Controller, County of Monterey.

DeMars, Edward. September 1975. Planning Director, County of Monterey.

Edgerton, John. January 1976. City Manager, City of Marina.

Engineering Science, Inc. June 1976. Table of alternative costs supplied by Bill Maddaus.

---------- 1976. September 24, 1976 letter of comment on the preliminary Draft EIS.

---------- 1976. Revised Chapter IX of the Draft Facilities Plan for North Monterey County.

Evans, Winslow. March 1976. California Department of Transportation, District 5, San Luis Obispo.

Filipponi, Herbert. March 1976. California Department of Transportation, Region 5, San Luis Obispo.

Ford, O. N. March 1976. Monterey Peninsula Airport District. September 1975.

Franco, Ernest. September and December 1975. Planning Department, City of Monterey.

Fraser, Jack. California Department of Fish and Game, Region III, Yountville, California.

Garrod, Richard. August 1975. Planning Director, City of Monterey.

Geiger, Mr. September 1975. Monterey County Flood Control and Water Conservation District

Gerdes, Gene. California Department of Fish and Game, Monterey.

Gibson, John. November 6, 1975. California Air Resources Board.

Granum, Fred. February 4, 1977. California Air Resources Board.

Hart, Al. 1976. City of Monterey, November 1976.

Heldt, Margret. 1976. Marina County Water District, November 1976.

Herring, John. February 4, 1977. California Air Resources Board.

Hodam, Robert. California State Water Resources Control Board.

Hodges, Jack. March 16, 1976. Senior Engineer for California State Water Resources Control Board.

Houston, Keith. September 1975. Pacific Gas & Electric Company, Salinas Office.

Huff, Peter. May 1976. California State Solid Waste Management Board.

Inman, John. September 1975. County of Monterey Agricultural Extension Service.

Jaques, Robert. 1976. Monterey Peninsula Water Pollution Control Agency, November 1976.

Jennings, Charles. 1976. California Division of Mines and Geology, July 1976.

Jenners, Ervin. March 1976. California Department of Transportation, District 5, San Luis Obispo.

Joens, Arnold. November 1976. City of Salinas, Department of Public Works.

Johnson, Kay. January 1976. U. S. Fish and Wildlife Service.

Johnson, Mike. California Department of Fish and Game, Monterey.

Jones, David. California State Water Resources Control Board.

Jopling, William. February 1976. California Department of Health, Berkeley, California.

Lapham, Dudley. Monterey Peninsula Water Pollution Control Agency, Manager, Monterey, California.

Lee, James. California State Water Resources Control Board.

Leif, Fred. U. S. Environmental Protection Agency, Region IX, Air and Hazardous Materials Division.

Leonard, William. April 1976. Regional Water Quality Control Board, Central Coast Region.

Lieberman, Daniel. April 22, 1976. California Air Resources Board.

Lobay, Tony. January 1976. Planning Department, City of Pacific Grove.

Loftin, William. January 1976. City of Livermore, Sanitation Department.

Loveday, Richard. August 1975. California Department of Transportation, Statewide Transportation Planning Department.

McBroom, James. November 1976. Seaside County Sanitation District.

McClain, Bruce. March 1976. Director of Public Works, Monterey County.

Mackay, Douglas. September 1975. U. S. Environmental Protection Agency.

Maddaus, William. Engineering Science, Inc.

Madruga, Joe. August 1975. Monterey County Flood Control and Water Conservation District.

Maloney, John. November 6, 1975. Monterey Bay Unified Air Pollution Control District.

Marra, Ed. October 6, November 7, 1975, January 16, 1976. U. S. Environmental Protection Agency.

Mehlert, John. March 1976. California Department of Parks and Recreation.

Mei, Anthony L. 1976-77. U. S. Environmental Protection Agency, Region IX,

Meiser, Gus. September 1975. Salinas Airport.

Miller, Claude. March 1976. California Department of Transportation, District 5, San Luis Obispo.

Minard, David. February 1976. U. S. Environmental Protection Agency, Region IX.

Monterey County Planning Department. January 1976. Monterey County zoning summary chart.

Morrow, Robert. U. S. Army Corps of Engineers, San Francisco.

Munson, Ed. September 1975. Consultant to Monterey County Environmental Health Department.

Nielson, Hardy. August 1975, January 1976. Planning Staff, City of Salinas.

Norton, Haywood. August 1975, January 1976. Planning Staff, City of Monterey.

Paskind, Jack. November 7, 1975. California Air Resources Board.

Pearson, Lawrence. California State Water Resources Control Board.

Peck, Omer. March 16, 1976. Agricultural Specialist for California State Water Resources Control Board.

Pintar, Joseph. August 1975. Facilities Engineer-Director, Fort Ord.

Pope, Joe. State Water Resources Control Board, Cultural Resources Offices, Sacramento.

Renaud, R. J. 1975. Wind data from the Department of Meteorology, U. S. Naval Post-Graduate School, Monterey, California.

Rugg, Mike. California Department of Fish and Game, Region III, Yountville, California.

Ryerson, James. April 22, 1976. California Air Resources Board.

Schiebe, Gerald. April 6, 22, 1976; January 20, 1977. California Air Resources Board.

Sederholm, R. March 1976. Southern Pacific Railroad.

Seible, Duane. November 6, 1975. California Air Resources Board.

Shahinian, George. November 7, 1975. California Air Resources Board.

Sheikh, Bahman. Engineering Science, Inc.

Silva, Tony. August 1975. U. S. Soil Conservation Service.

Smith, Emil. California Department of Fish and Game, Sacramento.

Snider, William. California Department of Fish and Game, Monterey.

Soil Control Labs. October 1976. Water quality tables from Soil Control Lab technical report 76-4: Pilot study - Moro Cojo Slough environmental analysis.

Spath, Mr. February, 1977. California Department of Health, Water Sanitation, Berkeley, California.

Speth, John. California Department of Fish and Game, Coastal Wetlands Program, Sacramento.

Taylor, Gene. 1975. Monterey County Flood Control and Water Conservation District.

Tesher, Tom. December 10, 1975. CalTrans, MCTS Office.

Thompson, Bruce. December 1975, January and March 1976. Monterey County Transportation Study.

Thompson, Foster. September 1975, March 1976. Planning Staff, Monterey County.

Thorup, Richard. January 1976. Geological Consultant to Monterey County.

U. S. Environmental Protection Agency. 1976. Excerpt from EIS (author unknown) supplied by Mark Brucker, Region IX.

Vestal, Eldon. May 1976. California Department of Fish and Game, Yountville.

Waters, James. 1976-77. California State Water Resources Control Board.

Weaver, Tony. 1976. Marine Biologist, Kinnetic Laboratories, Inc. Santa Cruz, California.

White, Luther. November 1976. Monterey County Department of Public Works.

Wilson, Mr. September 1975. Public Information Officer, Fort Ord.

Wong, Walter. Monterey County Environmental Health Department.

Woodruff, Robert. January 1976. Planning Director, City of Pacific Grove.

Wooster, Ted. California Department of Fish and Game, Region III, Yountville.

Xavier, Tony. February 3, 1977. California Air Resources Board.

Yarborough, Lee. September 1975. King City Airport.

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BACKGROUND DATA -- PHYSICAL ENVIRONMENT

APPENDIX A

AIR QUALITY

APPENDIX A-1

BACKGROUND INFORMATION ON AIR POLLUTION

Introduction

Any detailed discussion of air pollution issues requires an understanding of terms and phrases which are used in a technical or semi-technical sense. It is especially important to understand the distinction between air pollutant emissions and ambient air quality. The term "pollutant emissions" refers to the quantity of one or more specific compounds introduced into the atmosphere by a given source (or group of sources) during a specified time period. The term "ambient air quality" refers to the concentration (quantity per unit volume) of a specific compound in the atmosphere which results from the interaction of pollutant emissions, physical processes (meteorology) affecting the distribution of these pollutants, and chemical reactions in the atmosphere involving these pollutants. Thus, emissions represent the rate (amount per unit time) at which pollutants are added to the atmosphere, while air quality is the concentration (amount per unit volume of air) of a pollutant actually experienced at a particular geographic location.

It is customary to identify air pollutants either as specific chemical compounds (such as carbon monoxide [CO], nitric oxide [NO], nitrogen dioxide [NO_2], hydrogen sulfide [H_2S], sulfur dioxide [SO_2], sulfuric acid [H_2SO_4], ozone [O_3], hydrogen fluoride [HF], ethylene [C_2H_4], lead [Pb]) or as certain groups of compounds (such as total oxides of nitrogen [NO_x], oxides of sulfur [SO_x], photochemical oxidants [O_x], suspended particulates or aerosols, nitrates [NO_3^-], sulfates [$SO_4^=$], organic gases or hydrocarbons [HC]). As indicated above, some pairs of terms are often used interchangeably. The terms "aerosols" and "suspended particulate matter" are generally used as synonyms. Likewise, the terms "hydrocarbons" and "organic gases" are often used interchangeably. The term "organic gases" is usually more appropriate from a strictly technical standpoint than is the term "hydrocarbons".

Air pollutants, such as those identified above, are often categorized as being "primary" or "secondary" pollutants. Primary pollutants are those (such as CO, NO, H_2S, most SO_2, HF, Pb, and various aerosols and organic gases) which are emitted directly into the atmosphere. Secondary pollutants are those (such as most NO_2, H_2SO_4, O_3, NO_3^-, $SO_4^=$, and many aerosols and organic gases) which are produced from primary pollutants or other secondary pollutants by chemical reactions in the atmosphere. These chemical reactions may also involve compounds which are normal components of the atmosphere. Compounds which readily participate in such chemical reactions are often categorized as "reactive pollutants".

On a global scale, natural sources produce far greater quantities of most pollutants than do human activities. Yet because these natural sources are far less concentrated than human activities, they exert little impact on ambient air quality (Table A).

Meteorology

Meteorological factors are important to consider from several perspectives when evaluating air quality issues. Factors such as temperature, humidity, and the intensity and duration of sunlight play important roles in governing the nature and rate of chemical reactions in the atmosphere. Atmospheric turbulence, wind patterns and vertical temperature gradients are important factors governing the distribution and dispersion of pollutants. Atmospheric turbulence, wind patterns and precipitation processes affect the rate at which pollutants are removed from the atmosphere. Figure A summarizes the major structural features of the atmosphere.

Temperature Inversions

Under "normal" conditions, sunlight warms land surfaces which in turn heat the air at ground level by conduction and re-radiation of heat. When heated sufficiently, a pocket or "cell" of warmed air will expand and rise, being displaced by cooler, denser air from above. As it rises, the cell of warm air will expand further due to decreasing atmospheric pressure. This expansion due to decreasing pressure at higher altitudes causes the temperature of the air cell to drop. The air cell will continue to rise, expand in volume, and cool until it reaches an altitude where it is at the same temperature and pressure as surrounding air masses. This rising of warmed air and replacement by cooler air from above results in vertical mixing of the air column.

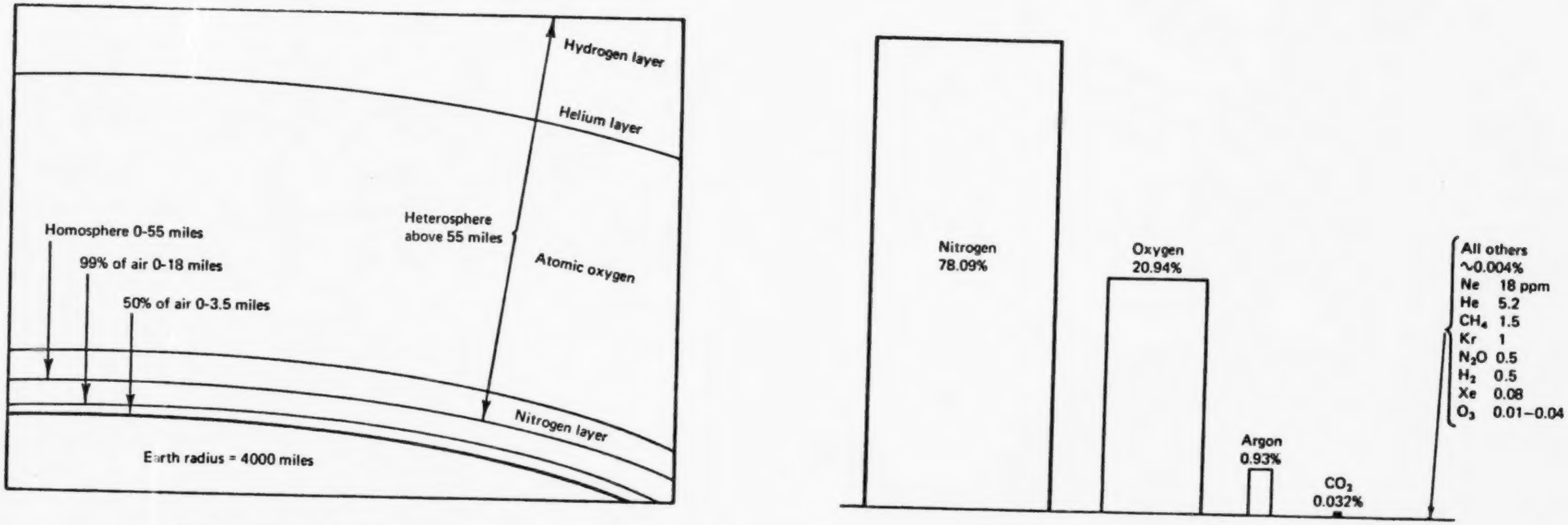
If, however, the air near ground level becomes colder (and thus denser) than the higher air masses, this vertical mixing ceases and a temperature inversion is formed -- air temperature increases with altitude. An inversion can form under a wide variety of circumstances. Radiation inversions often form during clear nights when the land surface cools faster than the air above it. Air at ground level thus cools

Table A

SUMMARY OF ANNUAL GLOBAL NATURAL AND MAN-CAUSED EMISSIONS OF MAJOR AIR POLLUTANTS

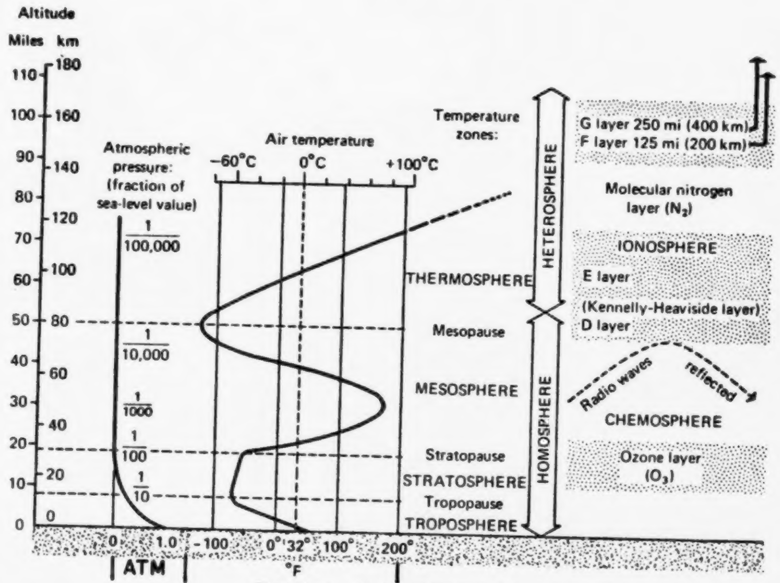
Contaminant	Major Pollution Sources	Natural Sources	Estimated Emissions (tons)		Atmospheric Background Concentrations	Calculated Atmospheric Residence Time	Removal Reactions and Sinks	Remarks
			Pollution	Natural				
SO_2	Combustion of coal and oil	Volcanoes	146×10^6	No estimate	0.2 ppb	4 days	Oxidation to sulfate by ozone or, after absorption, by solid and liquid aerosols	Photochemical oxidation with NO_2 and HC may be the process needed to give rapid transformation of $SO_2 \rightarrow SO_4$
H_2S	Chemical processes, sewage treatment	Volcanoes, biological action in swamp areas	3×10^6	100×10^6	0.2 ppb	2 days	Oxidation to SO_2	Only one set of background concentrations available
CO	Auto exhaust and other combustion	Photochemical oxidation of methane, forest fires, oceans, terpene reactions, volcanoes, decomposition of chlorophyll	304×10^4	3.47×10^9	0.1 ppm	1-4 months	Probably soil organisms and reaction with hydroxyl radical in stratosphere; possibly oxidation by NO_3	Ocean contributions to natural source probably low. Removal mechanisms poorly studied
NO/NO_2	Combustion	Bacterial action in soil (?)	53×10^6	NO: 430×10^6 NO_2: 658×10^6	NO: 0.2-2 ppb NO_2: 0.5-4 ppb	5 days	Oxidation to nitrate after sorption by solid and liquid aerosols, hydrocarbon photochemical reactions	Very little work done on natural process
NH_3	Waste treatment	Biological decay	4×10^6	1160×10^6	6 ppb to 20 ppb	7 days	Reaction with SO_2 to form $(NH_4)_2SO_4$ oxidation to nitrate	Formation of ammonium salts is major NH_3 sink
Hydrocarbons	Combustion exhaust, chemical processes	Biological processes	88×10^6	CH_4: 1.6×10^9 Terpenes: 200×10^6	CH_4: 1.5 ppm Non CH_4: <1 ppb	4 years (CH_4)	Photochemical reaction with NO/NO_2, O_3; large sink necessary for CH_4	"Reactive" hydrocarbon emissions from pollution equals 27×10^6 tons
CO_2	Combustion	Biological decay, release from oceans	1.4×10^{10}	10^{12}	325 ppm	2-4 years	Biological adsorption and photosynthesis, adsorption in oceans	Atmospheric concentrations increasing by 0.7 ppm/year

Source: Modified from E. R. Robinson and R. C. Robbins, 1972 (In: W. Strauss, ed., Part II), based on Urone, 1976 and Whelpdale and Munn, 1976.



Vertical distribution of air

Composition of dry air (% v/v).



Structure of the atmosphere

FIGURE A: STRUCTURE AND COMPOSITION OF THE ATMOSPHERE

Source: Modified from Urone, 1976.

more rapidly than air at higher altitudes, creating a temperature inversion. In mountainous areas, downslope movements of dense, cold air from higher elevations can create an inversion condition in valley areas. An influx of a shallow layer of cold air under a larger warm air mass will also create an inversion condition; this occurs frequently wherever cool sea breezes are common. A warm air mass moving into an area above a cold air mass at ground level can also create inversion conditions. A subsidence inversion forms when a large mass of air within a stagnant high pressure system sinks down over an area and is warmed by compression to a temperature higher than that of the surface air mass. This occurs because, as air from the center of a cell spreads outward, it is replaced by a sinking air mass from above.

Temperature inversions can form at ground level or at various altitudes above the land surface (Figure B). Both surface and elevated inversion layers may be present simultaneously. Surface inversions tend to break with normal daytime heating of the land while inversions aloft tend to be more persistent. The "magnitude" or strength of an inversion is indicated by the temperature difference between the base and the top of the inversion layer. The layer of air between ground level and the base of an inversion is called the "mixing layer".

Wind Patterns and Mixing of Pollutants

Wind patterns are of major concern in air pollution analysis because they govern the transport and dispersion of pollutants. Wind patterns near ground level are influenced significantly by topography. Ground level winds may also be significantly different (in regard to both velocity and direction) from winds at higher altitudes. The presence of inversion layers also influences, and is influenced by, wind patterns.

Several different patterns of long distance pollutant transport have been identified in California. The most frequent pattern involves transport by surface winds with the transported pollutants being mixed with pollutants generated in the downwind "receptor" areas.

Heating of interior valleys and mountain slopes can carry pollutants to higher altitudes. Under such conditions, pollutants often become concentrated in district layers (Figure C). If an elevated inversion layer is present, pollutants often concentrate just below the base of the inversion, or sometimes within the inversion layer. Breaks in inversion layers, especially over

Figure B

Typical Temperature/Altitude Profiles

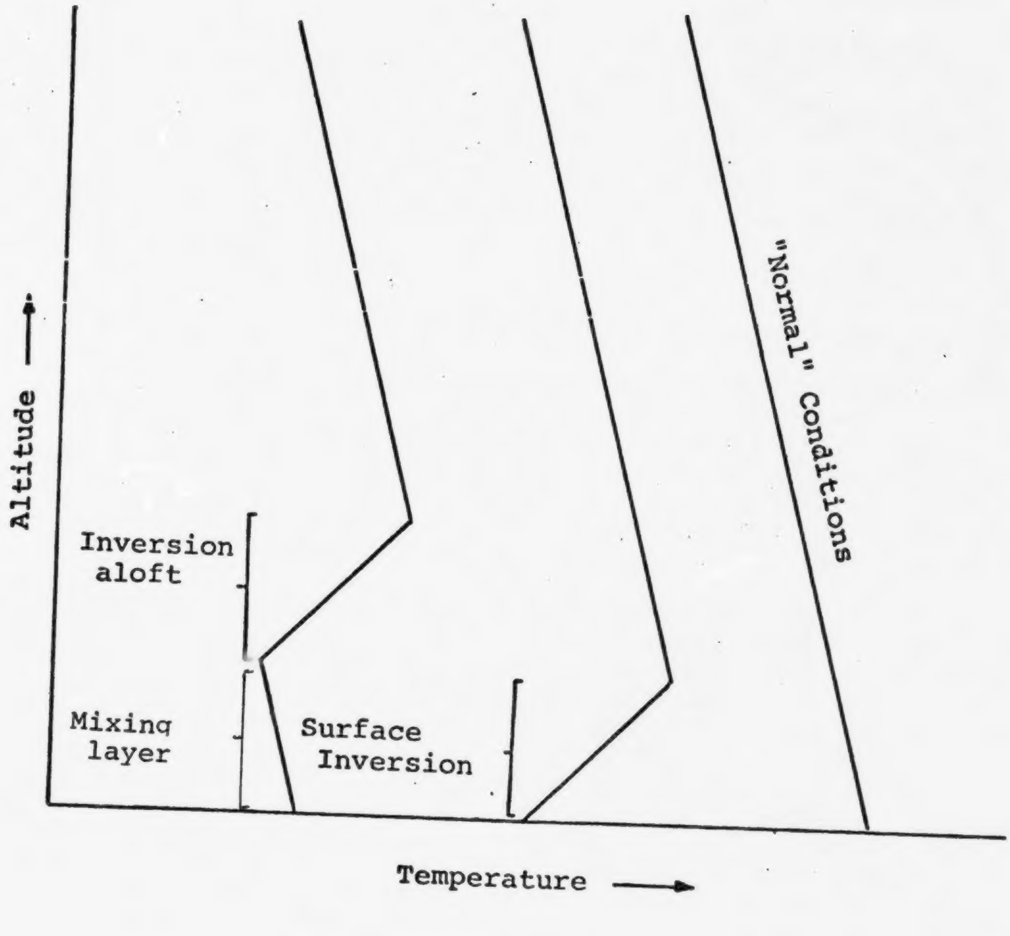
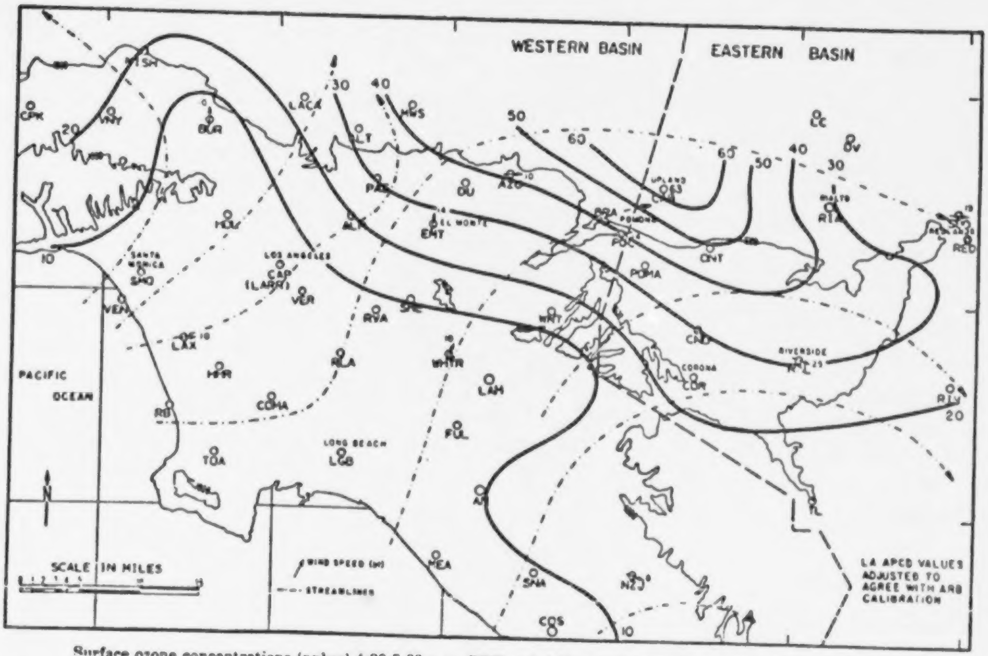
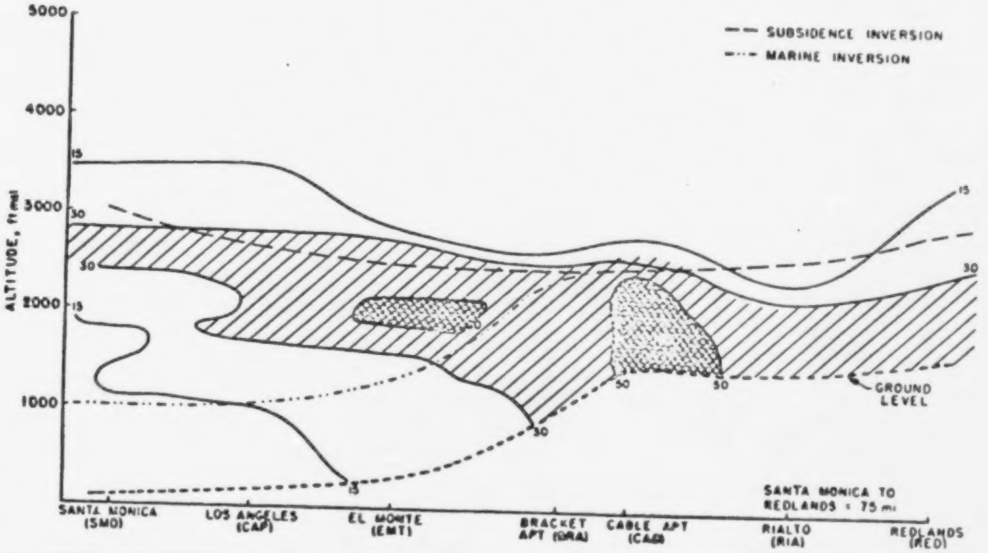


Figure C

OXIDANT DISTRIBUTION ON JULY 25, 1973



Surface ozone concentrations (pphm) 4:00-5:00 p.m. PDT and 4:00 p.m. PDT streamlines, July 25, 1973, in the South Coast Air Basin between sea level and the surrounding mountains.



Vertical cross section of ozone concentration (pphm) for late afternoon (4:30- 6:30 p.m. PDT) July 25, 1973, in the South Coast Air Basin between sea level and the surrounding mountains.

Source: Blumenthal, 1976.

areas of elevated terrain, can allow pollutants to be carried to altitudes above the top of the inversion or to be returned to ground level through turbulent mixing where the inversion has broken.

Pollutants carried in elevated strata can also be returned to ground level during periods of nighttime cooling, especially if the pollutants concentrate against mountain slopes. Pollutants which are transported to altitudes above the top of an inversion may be transported long distances by high altitude winds (which may flow counter to surface winds). Breaks in the inversion layer may subsequently return these pollutants to ground level.

Under certain conditions of generally light surface winds, pollutants may concentrate in a source area and be transported in-mass to a downwind area with little dilution occurring during transport. The transported mass of polluted air may also displace, rather than mix with, the air mass in the downwind receptor area.

Air Pollution Chemistry

Sulfur Compounds

Most air pollutant emissions of sulfur compounds are in the form of sulfur dioxide (SO_2), with smaller amounts being emitted as hydrogen sulfide (H_2S) or sulfur trioxide (SO_3). In the atmosphere, hydrogen sulfide is readily oxidized to sulfur dioxide. In "clean" air, SO_2 oxidizes slowly to SO_3; this reaction proceeds more rapidly in the heated exhaust plume from a combustion source. The oxidation of SO_2 to SO_3 is catalyzed (accelerated) by the presence of metallic particulates, especially iron and manganese salts, and by water vapor. This catalyzed reaction occurs most readily in droplets of water condensed around the metallic particulates. The oxidation of SO_2 to SO_3 is also enhanced by the presence of various intermediate chemicals which are created during the formation of photochemical oxidants (smog), and is inhibited by nitrogen dioxide.

Sulfur trioxide combines rapidly with water vapor to form sulfuric acid (H_2SO_4). Sulfuric acid reacts readily with various metal ions or atmospheric ammonium to form particulate sulfates, especially ammonium sulfate and calcium sulfate.

Oxides of Nitrogen

Seven different oxides of nitrogen are known to exist, but only two, nitric oxide (NO) and nitrogen dioxide (NO_2) are significant air pollutants. Nearly all pollutant emissions of nitrogen oxides occur as nitric oxide. Nitric oxide is generated by high temperature combustion of organic nitrogen compounds or by thermal fixation of nitrogen gas (N_2), which comprises 78 percent of air. Nitric oxide molecules can spontaneously decompose into nitrogen gas and oxygen (O_2), but the rate of this reaction is extremely slow at normal air temperatures. Most frequently, nitric oxide is oxidized to nitrogen dioxide, either slowly by atmospheric oxygen or rapidly by natural concentrations of ozone (O_3).

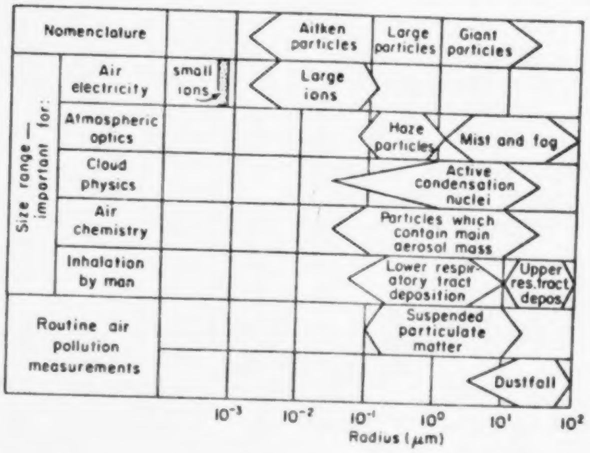
Nitrogen dioxide is rapidly oxidized by ozone, producing nitrogen trioxide (NO_3), which combines with NO_2 to form nitrogen pentoxide (N_2O_5). Nitrogen pentoxide combines readily with water vapor to form nitric acid (HNO_3). In fog droplets, nitrogen dioxide can be hydrated and catalytically oxidized directly to nitric acid. Nitric acid reacts readily with metal ions and atmospheric ammonium to form particulate nitrate salts. A reaction between nitrogen trioxide and carbon monoxide to produce nitrogen dioxide and carbon dioxide has recently been suggested by some researchers (Willix, 1976).

Several of the above compounds are photochemically active, undergoing various chemical reactions after absorbing energy from sunlight. Nitrogen dioxide in particular plays a major role in photochemical reactions (discussed below).

Aerosols

The term aerosols is applied to the whole range of solid or liquid particles that occur in the atmosphere. Some aerosols are living organisms or are derived from living organisms (i.e., pollen grains, viruses, bacteria, algae, protozoa, molds, fungi, yeasts, spores, etc.); these are often referred to as "viable particulates". Non-viable particulates are often classified as dispersion aerosols (formed by grinding or atomization of solids and liquids) or as condensation aerosols (formed when supersaturated or saturated vapors condense, or by chemical reactions among gases to form a volatile or non-volatile solid product). Aerosol sizes are often measured in units of microns (μm). One micron equals 1/1,000 millimeter, or slightly less than 4/100,000 inches (3.94×10^{-5} inches). Figure D illustrates additional aspects of terminology and the importance of aerosols in different size ranges.

Figure D. Terminology and Importance of Natural Aerosols.



Source: Corn, 1976.

The importance of aerosols in terms of atmospheric chemistry depends largely on the size and shape, surface electrical charge, and chemical composition of aerosol particles. Particle shapes are often classified as spherical, cubical, irregular, flakes, fibrous, or condensation flocks. Aerosols participate in chemical reactions in three different ways: by providing either a dry substrate or an aqueous environment in which other chemicals react; by participating in reactions as a catalyst; and by direct involvement as a primary reactant.

Photochemical Reactions

Photochemical reactions are those in which the energy content of sunlight (and ultraviolet radiation in particular) is absorbed by a compound and provides the activation energy necessary to initiate a variety of chemical reactions. The energy content of light depends upon its wavelength; the shorter the wavelength the higher the energy content. The stratospheric ozone layer generally prevents wavelengths below 2,900 angstroms (1 angstrom equals 10^{-10} meters, or 10^{-4} microns) from reaching the earth's surface.

If exposed to light of a short enough wavelength, a large number of chemicals will be decomposed. Compounds known to undergo photochemical decomposition in the lower atmosphere include nitrogen dioxide (NO_2), nitrous acid (HNO_2), nitric acid (HNO_3), hydrogen peroxide (H_2O_2), and various organic peroxides, aldehydes, ketones, and organic nitrates. Such photochemical decomposition usually leaves one or more of the decomposition products in a highly energized or reactive state.

Nitrogen oxides become involved in photochemical reactions in several ways. Nitric oxide reacts with ozone to produce molecular oxygen and nitrogen dioxide. This reduces oxidant levels, especially in the immediate vicinity of freeways, power plants, and other major high-temperature combustion sources. The nitrogen dioxide thus formed, however, participates in a complex series of chemical reactions leading to the formation of numerous photochemical oxidants, including ozone.

The photochemical oxidation process normally begins with the photochemical decomposition of nitrogen dioxide into nitric oxide and a free oxygen atom (O). Following this initial step, numerous organic gases, water vapor, nitrogen oxides, oxygen and ozone take part in a lengthy series of interdependent chemical reactions. During the course of these reactions, some of the nitrogen dioxide which initiated the process is converted to various complex organic nitrates. Most NO_2, however, serves only as an intermediate reactant and is eventually regenerated as nitrogen dioxide. This regenerated nitrogen dioxide is then available to initiate another sequence of photochemical reactions. Table B summarizes the current state of knowledge about some of the more important reactions which are believed to occur in the photochemical oxidation process.

The major products of the photochemical oxidation process are ozone, aldehydes (especially formaldehyde and acrolein), ketones, peroxyacyl nitrates (especially peroxyacetyl nitrate or PAN), organic nitrates, organic peroxides, hydrogen peroxides, carbon dioxide, and carbon monoxide. Ozone is normally the major product, but is so chemically reactive that high levels can be maintained in polluted air only while it is being continuously generated by the photochemical oxidation process. Thus, ozone levels rapidly decline at night or during cloudy weather. High ozone levels may persist throughout the night or for a few days if a mass of smog is transported into an area having few local pollution sources. This situation is due to the absence of other chemicals with which ozone can react.

Table B

REACTION RATES FOR IMPORTANT STEPS IN THE PHOTOCHEMICAL OXIDATION PROCESS

Reaction	*Comments*
1. $NO_2 + h\nu \rightarrow NO + O$	$k_a\varnothing$ uncertain by ~20%; difficulties encountered in trying to relate measured k_d to $k_a\varnothing$
2. $O + O_2 + M \rightarrow O_3 + M$	Well known; $k = 2.0 \times 10^{-5}$ ppm^{-2} min^{-1}
3. $O_3 + NO \rightarrow O_2 + NO_2$	$20 \leq k \leq 40$ ppm^{-1} min^{-1}
4. $O_3 + NO_2 \rightarrow NO_3 + O_2$	Two measured values, 0.11 and 0.048 ppm^{-1} min^{-1}, both of which may be too high
5. $NO_3 + NO_2 \rightarrow N_2O_5$	k_5 and k_6 uncertain by ~20%; equilibrium constant is very temperature dependent
6. $N_2O_5 \rightarrow NO_3 + NO_2$	
7. $N_2O_5 + H_2O \rightarrow 2HNO_3$	Reaction in gas phase is negligible; reaction occurs only on surfaces
8. $NO_3 + NO \rightarrow 2NO_2$	k factor of 10^2 uncertainty; most important NO_3 removal process
9. $NO_3 + h\nu \rightarrow NO_2 + O$	Importance not determined
10. $NO + NO_2 + H_2O \rightarrow 2HONO$	Rate may be higher than first order with respect to H_2O; heterogeneous contributions to this rate not determined
11. $2HONO \rightarrow NO + NO_2 + H_2O$	
12. $HONO + h\nu \rightarrow OH + NO$	$k_{12} \sim 0.1\, k_a\varnothing$; photolysis of HONO in early morning may initiate smog formation
13. $OH + NO_2 + [M] \rightarrow HNO_3 + [M]$	k uncertain; order of reaction depends on pressure of M; probably second order in atmosphere
14. $OH + NO + [M] \rightarrow HONO + [M]$	k uncertain; pressure dependence not determined
15. $OH + CO \rightarrow CO_2 + H$	$230 \leq k \leq 280$ ppm^{-1} min^{-1}; reaction is too slow to compete with olefin–OH reactions
16. $H + O_2 + M \rightarrow HO_2 + M$	Only atmospheric reaction of importance for H atoms
17. $HO_2 + NO \rightarrow HO + NO_2$	$10^2 \leq k \leq 10^3$ ppm^{-1} min^{-1}; most important HO_2 removal process
18. $2HO_2 \rightarrow H_2O_2 + O_2$	k uncertain by ~50%
19. $H_2O_2 + h\nu \rightarrow 2OH$	Photolysis rate in sunlight not well known
20. Paraffins $+ O \rightarrow R + OH$	k uncertain by ~ factor of 10
21. Paraffins $+ OH \rightarrow R + H_2O$	k uncertain by ~ factor of 10
22. Olefins $+ O \rightarrow ?$	k factor of 2 uncertainty; products of reaction under atmospheric conditions unknown
23. Olefins $+ OH \rightarrow ?$	Most important olefin reaction; products of reaction unknown
24. Olefins $+ O_3 \rightarrow$ aldehyde + zwitterion	k factor of 2 uncertainty; reactions of zwitterion unknown
25. Olefins $+ H_2O \rightarrow ?$	Probably unimportant
26. Aromatics $+ O \rightarrow R + OH$	k's for most reactions unknown; $k_{26} \sim k_{20}$
27. Aromatics $+ OH \rightarrow R + H_2O$	k's for most reactions unknown
28. $RCHO + h\nu \rightarrow R + HCO$	Quantum yields as function of $h\nu$ not well known; k_{28} may be an important chain initiation step in atmosphere
29. $RCHO + h\nu \rightarrow RH + CO$	
30. $RCHO + OH \rightarrow RCO + H_2O$	$k \sim 10^4$ ppm^{-1} min^{-1}
31. $RCHO + O \rightarrow RCO + OH$	Slow compared to R. 30
32. $HCO + O_2 \rightarrow HO_2 + CO$	k high; only important HCO reaction
33. $RCO + O_2 \rightarrow RC(O)OO$	Only RCO reaction of importance
34. $RC(O)OO + NO \rightarrow R + CO_2 + NO_2$	k unknown
35. $RC(O)OO + NO_2 \rightarrow RC(O)OONO_2$	k unknown
36. $R + O_2 \rightarrow RO_2$	Very fast
37. $RO_2 + NO \rightarrow RO + NO_2$	k unknown
38. $RO_2 + NO_2 \rightarrow RO_2NO_2$	k unknown
39. $RO_2 + HO_2 \rightarrow ROOH + O_2$	k unknown
40. $RO + O_2 \rightarrow RCHO + HO_2$	k unknown
41. $RO + NO \rightarrow RONO$	k unknown
42. $RO + NO_2 \rightarrow RONO_2$	k unknown

NOTES:
$h\nu$ light energy
M energy absorbing molecule or catalyst
R hydrogen atom or hydrocarbon group

Source: Hecht, 1973, as presented in Haagen-Smit and Wayne, 1976.

Under certain conditions the initial photochemical reaction during which nitrogen dioxide is decomposed can be replaced by the photochemical decomposition of various organic compounds, halogens or metal oxides (Haagen-Smit and Wayne, 1976). Haagen-Smitt and Wayne (1976) cite Adams and Schneider (1952) as documenting an instance where the combined emissions of styrene ($C_6H_5CHCH_2$) and halogens produced eye irritants through a photochemically catalyzed process.

Paskind and Kinosian (1974) present evidence that oxidant levels depend on not only the absolute amounts, but also the ratio between hydrocarbon and nitrogen oxide levels. Oxidant levels will increase or decrease with corresponding changes in hydrocarbon levels. A change in nitrogen oxide levels (either increase or decrease) may, depending on the relative quantities of hydrocarbons present, produce either an increase or a decrease in oxidant values. This situation is due to the various roles which nitrogen oxides can play during the photochemical reaction process and to the chemical reactivity of ozone. Both Paskind and Kinosian (1974) and Pitts, et.al. (1975) present data suggesting that a reduction of nitrogen oxide levels in such heavily urbanized areas as central Los Angeles and northern Orange Counties will probably enhance rather than reduce the formation of photochemical oxidants (Figure E).

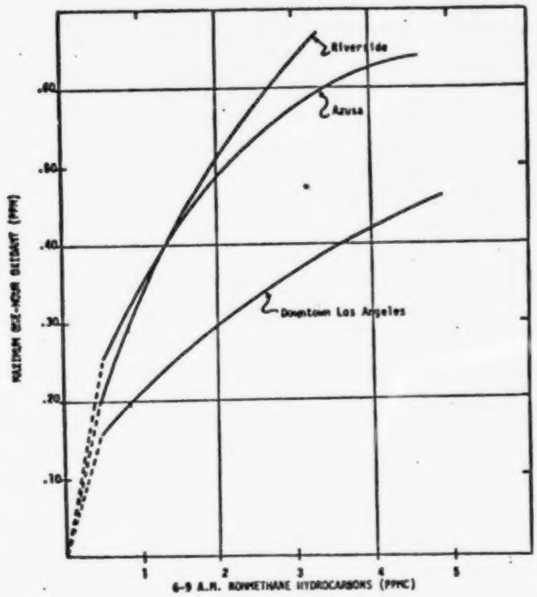
Five major groups of organic gases are normally involved as primary reactants in the photochemical oxidation process: alkanes (paraffins), alkenes (olefins), acetylenes, aromatic hydrocarbons and aldehydes. Several attempts have been made to classify organic gases according to their tendency to participate in photochemical reactions. While differing in details and in the number of reactivity classes used, most studies indicate the following type of classification.

High Reactivity. Internally double-bonded olefins, especially tri- and tetraalkyl ethylenes.
Moderate Reactivity. Polyalkyl benzenes, monoalkyl ethylenes, 1,3-alkadienes.
Low Reactivity. Ethylene, monoalkyl benzenes, alkanes (C_4 and higher).
Negligible Reactivity. Benzene, acetylene, methane, ethane, propane.

Table C presents the reactivity classification currently used by the California Air Resources Board. It should be noted that chemical reactivity is not always correlated with the extent to which a compound or its reaction products cause physiological effects on people, plants or animals.

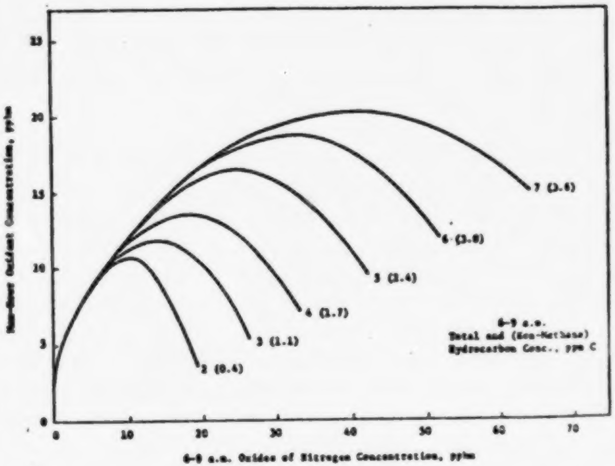
Figure E

NONLINEAR RELATIONSHIPS AMONG HYDROCARBON, NITROGEN OXIDES AND OXIDANT VALUES

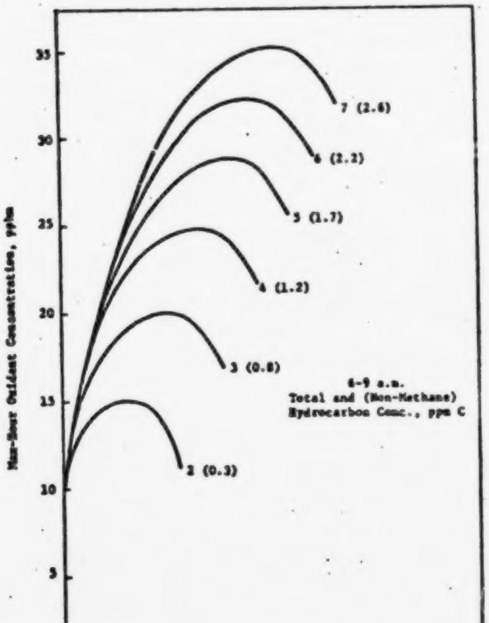


Basis for Schuck/Papetti Oxidant Model

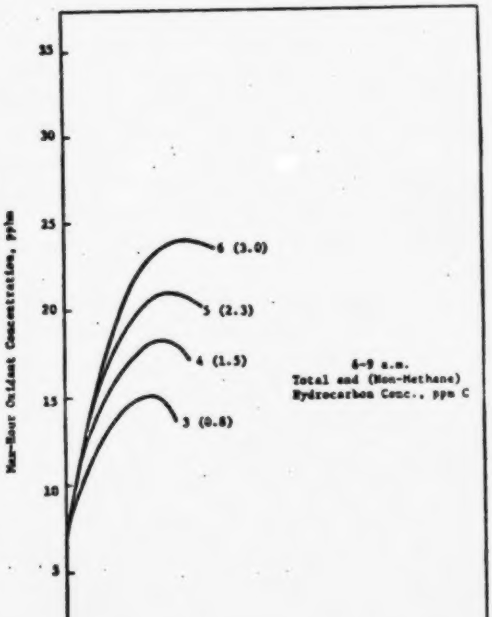
Upper Limit Curves for Three Stations in the Metropolitan Los Angeles AQCR (1)



Pollutant relationships at Los Angeles. Data period: July-Sept. 1969-1972. (2)



Pollutant relationships at Azusa. Data period: July-Sept. 1969-1972. (2)



Pollutant relationships at San Bernardino. Data period: July-Sept. 1969-1972. (2)

Sources: (1) Boundaries and Forecasting Committee, 1976.
(2) Paskind and Kinosian, 1974.

Table C

AIR RESOURCES BOARD
REACTIVITY CLASSIFICATION OF ORGANIC COMPOUNDS

Class I (Low Reactivity)	Class II (Moderate Reactivity)	Class III (High Reactivity)
C_1-C_2 Paraffins	Mono-tert-alkyl-benzenes	All other aromatic hydrocarbons
Acetylene	Cyclic Ketones	All Olefinic hydrocarbons (including partially halogenated)
Benzene	Alkyl acetates	Aliphatic aldehydes
Benzaldehyde	2-Nitropropane	Branched alkyl Ketones
Acetone	C_3+ Paraffins	Cellosolve acetate
Methanol	Cycloparaffins	Unsaturated Ketones
Tert-alkyl alcohols	n-alkyl Ketones	Primary & secondary C_2+ alcohols
Phenyl acetate	N-methyl pyrrolidone	Diacetone alcohol
Methyl benzoate	N,N-dimethyl acetamide	Ethers
Ethyl Amines	Alkyl Phenols*	Cellosolves
Dimethyl formamide	Methyl phthalates**	Glycols*
Perhalogenated Hydrocarbons		C_2+ Alkyl phthalates**
Partially halogenated paraffins		Other Esters**
Phthalic Anhydride**		Alcohol Amines**
Phthalic Acids**		C_3+ Organic acids + di acid**
Acetonitrile*		C_3+ di acid anhydrides**
Acetic Acid		Formin** (Hexa methylene-tetramine)
Aromatic Amines		Terpenic hydrocarbon
Hydroxyl Amines		Olefin oxides**
Naphthalene*		
Chlorobenzenes*		
Nitrobenzenes*		
Phenol*		

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*Reactivity data are either non-existent or inconclusive, but conclusive data from similar compounds are available; therefore, rating is uncertain but reasonable.

**Reactivity data are uncertain.

Source: California Air Resources Board, 1976b.

Pollutant Removal Mechanisms

Pollutants which are added to or formed in the atmosphere are removed through six general mechanisms: gravitational settling; impaction on surfaces; precipitation processes; diffusion into bodies of water; chemical reactions; and biological uptake or metabolism. Primary and secondary aerosols are removed from the atmosphere primarily by the first three processes, while gaseous pollutants are removed primarily by the last four processes.

Removal of Aerosols

The rate at which aerosols settle out of the air depends on the size, weight and shape of the particle, as well as on such meteorological factors as wind speed, vertical temperature gradients and atmospheric turbulence. Spherical particles settle more rapidly than non-spherical particles. In calm air, particles smaller than a few microns in diameter show little or no tendency to settle, being kept in suspension by the random motion of air molecules and similar forces. Small particles will often adhere to each other when they come in contact. Such coagulation of small particles can produce aerosols large enough to settle out of the atmosphere. Aerosols will also adhere to the surface of objects at the earth's surface when blown against them. Removal by impaction occurs most effectively with larger particles and on wet surfaces.

Aerosols larger than about 0.1 micron in diameter are, depending on chemical composition, capable of serving as condensation nuclei in the process of mist, fog or cloud formation. Water-insoluble particles within this size range may also become involved as condensation nuclei following agglomeration with smaller hygroscopic particles or adsorption of water-soluble gases or vapors. Water droplets, ice crystals or snow flakes formed by such processes can be increased in size by continued condensation or by collision and agglomeration of droplets to the point where the resulting drops or flakes fall to earth. "Rainout" of particulates which serve as condensation nuclei represents a major mechanism for removal of aerosols. "Washout" of aerosols occurs when a falling raindrop or snowflake accumulates other particles as it falls. Such washout mechanisms are ineffective in removing particles smaller than 2 microns in diameter, and are most effective in removing particles which have become wetted by condensation of water vapor or other gases.

Removal of Gaseous Pollutants

Table D identifies pollutant removal mechanisms (sinks) which affect various gaseous air pollutants.

As discussed previously, gaseous pollutants such as sulfur and nitrogen oxides undergo chemical reactions which produce liquid or solid aerosols. These aerosols can serve as condensation nuclei, resulting in rainout or washout of the pollutants. In addition, many gaseous pollutants are at least slightly soluble in water. These pollutants can diffuse into water droplets formed around condensation nuclei, and thus experience washout in this fashion. Because diffusion occurs in proportion to concentration differences, it is possible for pollutants to diffuse into water droplets in one area, be transported by winds to a different area, and diffuse out of the droplets at the second area. Diffusion can also occur into or out of water bodies such as rivers, lakes and oceans.

Chemical reactions involving gaseous pollutants have been discussed previously. These reactions can transform pollutants into normal constituents of the atmosphere, secondary gaseous pollutants, or secondary aerosol pollutants. In addition to chemical reactions in the atmosphere, reactions can occur as pollutants come in contact with objects at the earth's surface.

A final mechanism for removal of gaseous pollutants involves biological processes. Most living organisms, but especially microorganisms and higher plants, absorb many atmospheric gases. Pollutants in these gases may be stored in living tissue, biochemically decomposed to other substances by normal metabolic processes, or may react chemically or biochemically with living tissues. The results of these reactions and metabolic processes may be either detrimental, beneficial or innocuous to the organisms involved.

It is often assumed that removal processes such as those described above are, over any period of a few years, able to prevent any permanent increase in average global concentrations of most pollutants. For most pollutants, however, monitoring instruments are both insufficiently sensitive and inadequately located to provide reliable evidence regarding long-term, global trends in pollutant concentrations. There is, on the other hand, reliable evidence of a global, long-term trend of increasing carbon dioxide (CO_2) levels, most likely related to increasing combustion of fossil fuels (see Table A). Carbon dioxide, however, is seldom viewed as an air pollutant on a local or regional level. There is also significant evidence that suspended particulate levels are increasing, at least over much of the northern hemisphere. Much of this increase appears to be due to photochemically generated aerosols (Whelpdale and Munn, 1976).

Table D

REMOVAL MECHANISMS FOR GASEOUS POLLUTANTS

Substance	*Sinks*
Sulfur dioxide	Precipitation scavenging: washout, rainout
	Oxidation in gas and liquid phase to sulfate
	Soil: microbial degradation, physical and chemical reaction, absorption
	Vegetation: sorption on surfaces, stomatal intake
	Oceans, lakes: absorption
Hydrogen sulfide	Oxidation to sulfur dioxide
Ozone	Chemical reaction on vegetation, soil, snow and ocean surfaces
Nitrous oxide	Soil: microbiological destruction
	Stratosphere: photodissociation
	Ocean: absorption
Nitric oxide/ nitrogen dioxide	Soil: chemical reaction
	Vegetation: sorption, stomatal uptake
	Chemical reaction in gas and liquid phase
Ammonia	Chemical reaction to ammonium in gas and liquid phase
	Precipitation scavenging: washout, rainout
	Surface uptake: physical and chemical reaction, absorption
Carbon monoxide	Stratosphere: reaction with hydroxyl radical
	Soil: microbiological activity
Carbon dioxide	Vegetation: photosynthesis, absorption
	Oceans: absorption
Methane	Soil: microbiological activity
	Vegetation: chemical reaction, bacterial action
	Troposphere and stratosphere: chemical reaction
Hydrocarbons	Chemical reaction to particulates
	Soil: microbiological activity
	Vegetation: Absorption, stomatal intake

Source: Whelpdale and Munn, 1976.

Effects of Air Pollutants

The effects of air pollutants can generally be categorized as visibility reduction and light scattering; meteorological effects; damage to materials and structures; physiological effects on living organisms; and psychological effects on people.

Visibility Reduction

Visibility reduction by air pollutants is caused primarily by aerosols, although colored gases or water vapor may be significant in special cases. Reduced visibility can be due to dense accumulations of particulates blocking light transmittance by obstruction, or to scattering of light by lower concentrations of aerosols. Significant visibility reduction due to light scattering is often associated with the condensation of water vapor or other liquids around particulates in the 0.1 to 1.0 micron size range. Visibility reduction per se has two major types of consequences -- transportation-related hazards and aesthetic impacts.

Meteorological Effects

Meteorological effects of air pollutants are experienced on both an areawide or local scale and on a global or continental scale. Local or areawide meteorological effects are due mostly to the emissions of aerosols, heat and water vapor. While heat emissions in themselves are seldom viewed as air pollution, heat added to the atmosphere, especially in urban areas, can affect certain meteorological conditions. Urban areas are enveloped by a mass of air that is generally warmer than the air masses over adjacent rural areas. This temperature difference is most pronounced at night, when maximum temperature differences of 3-10°C (6-21°F) can occur. Mean annual temperature differences between adjacent urban and rural areas are usually 0.5-1.5°C (1-3°F). These temperature differences can have significant effects on the local transport and dilution of air pollutants.

The major meteorological effect of local air pollution involves influences on precipitation phenomena. An increase in local aerosol levels (either primary or secondary aerosols) can significantly increase the frequency of fog occurrences, and will in some cases increase cloud cover and/or precipitation rates. The increased occurrence of haze and fog can also affect local thermal and light intensity regimes. If ambient aerosol levels are often high, significant emissions of water vapor can also lead to increased fog or haze formation. Table E summarizes the meteorological effects of urbanization and its attendant pollutant emissions.

Table E

AVERAGE CHANGES IN CLIMATIC ELEMENTS CAUSED BY URBANIZATION

Element	Comparison with Rural Environment
Contaminants:	
condensation nuclei and particles	10 times more
gaseous admixtures	5 to 25 times more
Cloudiness:	
cover	5 to 10 percent more
fog—winter	100 percent more
fog—summer	30 percent more
Precipitation:	
totals	5 to 10 percent more
days with less than 5 mm	10 percent more
snowfall	5 percent more
Relative humidity:	
winter	2 percent less
summer	8 percent less
Radiation:	
global	15 to 20 percent less
ultraviolet—winter	30 percent less
ultraviolet—summer	5 percent less
sunshine duration	5 to 15 percent less
Temperature:	
annual mean	0.5° to 1.0° C more
winter minima (average)	1° to 2° C more
heating degree days	10 percent less
Wind speed:	
annual mean	20 to 30 percent less
extreme gusts	10 to 20 percent less
calms	5 to 20 percent more

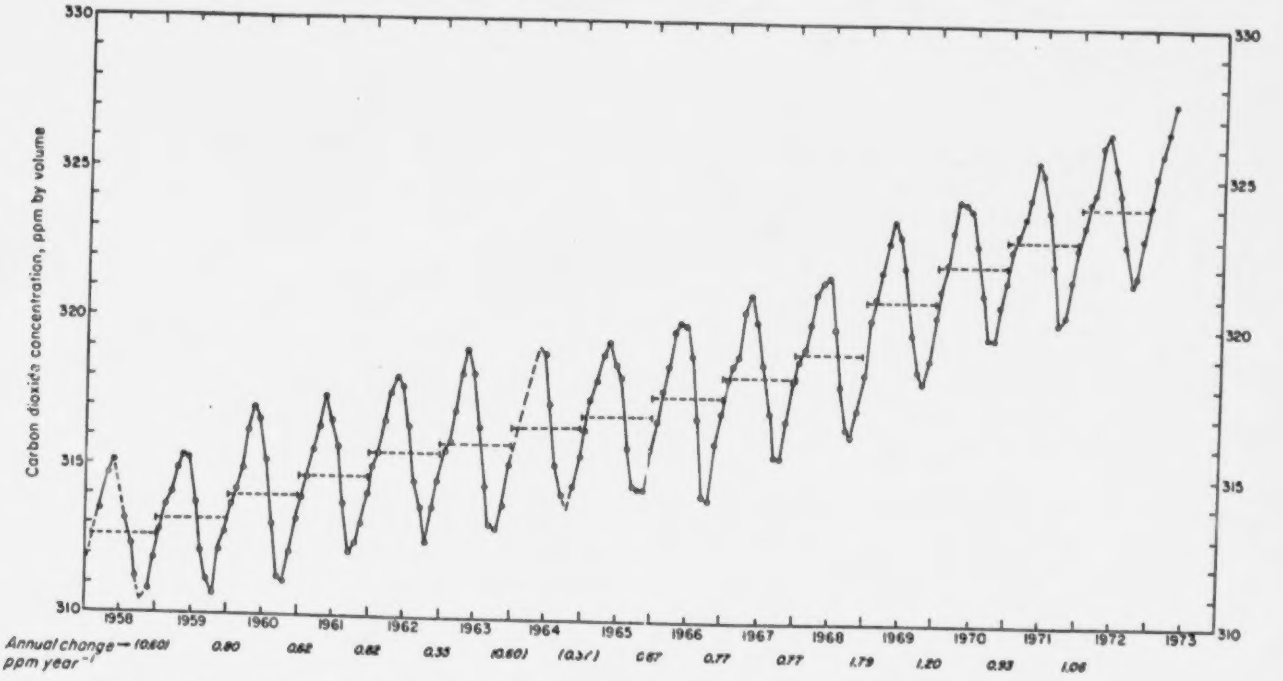
Source: Landsberg, 1970.

On a global and continental scale, three major types of air pollution effects on climate are evident. Global increases in carbon dioxide levels (Figure F) are influencing global temperature regimes. Most of the energy content of sunlight reaching the earth's surface is in the shorter wavelengths of light (toward the ultraviolet portion of the spectrum). Heat produced by absorption of sunlight is radiated as longer wavelengths (toward the infrared portion of the spectrum). Carbon dioxide and water vapor are strong absorbers of infrared radiation; thus, an increase in CO_2 levels in the lower atmosphere traps heat radiated from the earth's surface (the "greenhouse effect").

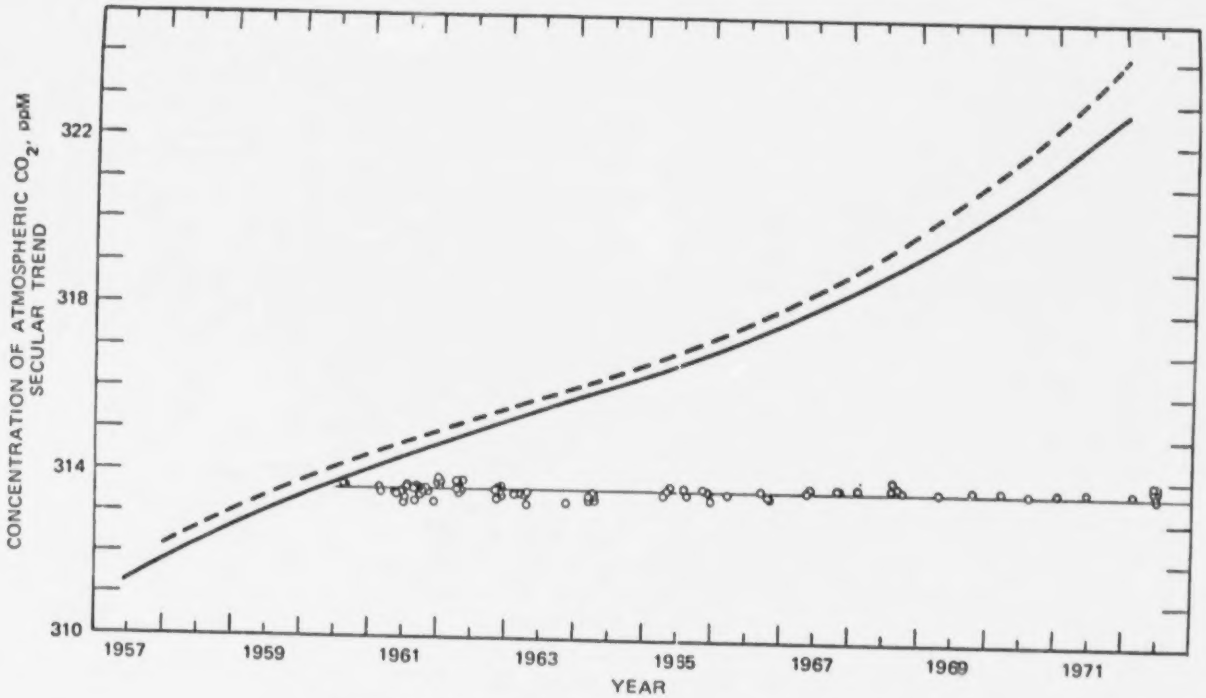
The apparent increase in aerosol concentrations is probably affecting global climatic factors in two major ways. Particulates directly reflect incoming solar radiation back toward space, thus reducing the amount of sunlight reaching the earth's surface. Increases in cloud cover due to condensation of water vapor around aerosols also result in increased reflectance of solar radiation. High altitude cirrus clouds may be especially important in this regard.

Pollutant effects on the stratospheric ozone layer (Figure A) have received significant attention in recent years. This ozone layer shields the earth's surface from high energy, shortwave radiation. Direct injection of combustion products from aircraft flying through the stratosphere could produce reductions in the ozone layer. Both water vapor and oxides of nitrogen would convert stratospheric ozone to molecular oxygen. There is significant uncertainty regarding the potential magnitude of current and future stratospheric ozone reductions from this source.

Most pollutants emitted into the lower atmosphere are unlikely to reach the stratospheric ozone layer due to chemical reactions, precipitation phenomena, and other removal mechanisms operating in the troposphere. Certain compounds which are chemically unreactive under conditions prevailing in the lower atmosphere may, when exposed to intensive ultraviolet radiation in the stratosphere, become involved in chemical reactions in the stratospheric ozone layer. Various chlorofluorcarbons (Freons) are of special concern in this regard, because of the large quantities produced industrially (850,000 tons in 1973), their use as aerosol propellants resulting in direct discharge to the atmosphere, and the lack of significant natural removal from the lower atmosphere (Freons are insoluble in water). Upon exposure to intense ultraviolet light, Freons ($CFCl_3$ and CF_2Cl_2) decompose, releasing chlorine atoms (Cl^-). The chlorine atoms take part in several chemical reactions which convert ozone to molecular oxygen.



Mean monthly carbon dioxide concentrations at Mauna Loa. Horizontal dashed lines indicate average yearly value. Annual changes in parenthesis are based on incomplete record



Comparisons of secular trends of atmospheric CO_2 concentration at Mauna Loa and the South Pole. The dashed curve is for Mauna Loa; the full curve for the South Pole. ○: analyses of a Scripps Institution surveillance reference gas whose mean value is plotted as a straight line.

FIGURE F. GLOBAL CARBON DIOXIDE LEVELS

SOURCES: WHELPDALE & MUNN, 1976
EKDAHL & KEELING, 1973

Reductions in the stratospheric ozone layer will result in increased levels of ultraviolet radiation reaching the earth's surface. Because of its high energy content, ultraviolet light can be physiologically damaging to living tissues and has the potential for causing an increase in genetic mutation rates. Increased ultraviolet radiation might also affect weather patterns through increased heating of the earth's surface and lower atmosphere. Increased ultraviolet radiation could also affect the rates of various chemical reactions, either in the atmosphere, in water, or on surfaces or structures. The potential magnitude of such effects due to any given reduction in the stratospheric ozone layer is at present uncertain.

Damage to Materials and Structures

Air pollutants affect materials and structures either through physical soiling (deposition of particulates) or through chemical reactions (which depend on the chemical composition of both the air pollutant and the material affected). Aerosols are involved in chemical reactions both as primary reactants and as catalysts which speed reactions between other pollutants and materials or structures.

Sulfur oxides, nitrogen oxides, hydrogen fluoride, hydrogen chloride, and numerous other air pollutants combine with water vapor to form strong acids which can corrode, dissolve, or otherwise damage a wide variety of materials. In addition to man-made materials and structures, soils, rock surfaces and bodies of water can be affected by acidic aerosols or by acid precipitation. The potential for acid precipitation depends not only on the presence of acid precursors during the normal precipitation seasons, but also on the extent and rate at which other atmospheric constituents can neutralize the acids through the formation of particulate salts (Winkler, 1976).

Pollutants which are strong oxidizing agents (NO_2 and ozone in particular) can cause a number of chemical reactions which damage materials. Pigments, dyes, synthetic textiles and rubber are among the prominent materials affected.

Physiological Effects

Physiological effects of various air pollutants on human health, vegetation and laboratory animals have been well studied, even though many issues remain unresolved. Most studies have involved exposure to single pollutants, rather than to the types of pollutant mixtures which occur in the atmosphere. The effect of simultaneous exposure to two or more compounds may be qualitatively or quantitatively different from the effects of either compound experienced alone. In addition, the presence of one compound may increase the magnitude of an effect produced by a given amount of a second compound (synergistic effect). Antagonistic effects occur when the presence of one compound inhibits or reduces the effect of a second compound. When two compounds produce similar effects, exposure to a mixture of the two may produce a synergistic, antagonistic, or an additive effect.

Human Health. A variety of different health effects of air pollutants have been recognized. The most frequently observed effect involves irritation of the respiratory system. Long-term exposure to respiratory irritants can greatly increase the chances of chronic respiratory diseases such as chronic bronchitis, pulmonary emphysema and lung cancer. Short-term exposure to high pollutant dosages can cause acute respiratory problems or even death. Pollutants usually identified as contributors to respiratory problems include ozone, nitrogen dioxide, oxides of sulfur, sulfuric acid mists, and aerosols. The combination of particulates and sulfur oxides (probably sulfates and sulfuric acid) is suspected of being the cause of several severe pollution episodes in which deaths were clearly attributable to air pollution. The 1930 air pollution episode in the Meuse Valley of Belgium resulted in 60 deaths and thousands of illnesses. The 1948 Donora, Pennsylvania episode caused 20 deaths and nearly 6,000 illnesses in a town of 14,000. The 1952 London episode produced about 4,000 deaths. A 1962 London episode produced 750 deaths. Air pollution episodes in New York City are considered responsible for causing about 400 deaths in 1963 and 168 in 1966 (American Lung Association, 1974).

Eye irritation is a second widespread effect of air pollution. Ozone, nitrogen dioxide, PAN, and other oxidants are primarily responsible. When absorbed into the blood stream, carbon monoxide, ozone and nitrogen oxides can reduce the oxygen-carrying ability of hemoglobin; carbon monoxide is usually responsible for serious effects in this regard. Respiratory allergies such as asthma can be triggered by a variety of aerosols, sulfur dioxide or ozone. Asthma-producing aerosol pollutants may be either nonviable aerosols (primarily dusts and organic particulates) or viable aerosols (pollen, molds, etc.). It should be noted that viable particulates may be attributable to human actions (agriculture, composting operations, sewage treatment plants) as well as natural sources.

A variety of metallic aerosols and organic compounds are known to be directly toxic to man. Most of these are seldom encountered at concentrations producing acute toxic effects. Some of these compounds, however, may be accumulated and stored in body tissues over extended periods of time. Some organic compounds are also suspected as having carcinogenic (cancer-causing) properties.

There are some indications that chronic exposure to nitrogen dioxide and ozone increases susceptibility to bacterial infection. Bacteria, viruses, fungi, and molds contained in viable aerosols also have the potential for producing infectious diseases if inhaled.

Effects on Animals. The effects of air pollutants on domestic animals, livestock and wildlife can be expected to be similar to the human health effects discussed above. The relative sensitivity of different species will vary considerably, however. While effects of pollutants on laboratory animals, domestic pets and livestock have received some study, effects on wildlife have received very little study.

A number of fish kills in the northeastern United States and in Scandinavia have been attributed to pH changes in lakes and ponds produced by frequent acid rains. In the San Gabriel Mountains of San Bernardino County, older bighorn sheep have been found to be totally or partially blind from what appear to be cataracts (white blotches on the eyeball). This eye damage has been noted only in those parts of the bighorn range subject to high oxidant concentrations (Taylor, *et.al.*, 1973). No study has yet been made to determine whether this condition is in fact caused by air pollution.

Effects on Vegetation. Air pollutants have been reported as affecting vegetation through three types of processes: direct physiological effects (Table F); altered susceptibility to other environmental stresses; and changes in soil properties affecting plants. Direct physiological effects of air pollution may result in visible symptoms of injury to leaves, stems, flowers or roots; hidden symptoms are evidenced as changes in plant metabolism and growth rates.

Air pollutants which have been identified as causing vegetation damage include sulfur dioxide, ozone, peroxyacyl nitrates, nitric oxide, nitrogen dioxide, ethylene, various fluoride compounds, and various particulates. The exact mechanisms by which various air pollutants exert their effects are not fully understood. Most pollutants appear to affect the structure and permeability of cell membranes, at least at high dosages. Other observed effects include destruction of

Table F

EFFECTS OF AIR POLLUTANTS ON VEGETATION

Pollutant	*Sources*	*Plant Symptoms of Injury*	*Injury Threshold*	
			Parts per Million (ppm)	*Periods of Exposure*
Sulfur dioxide (SO_2)	Combustion of coal, fuel oil, and petroleum; oil refineries	Bleached areas on leaves; yellowing of leaves; growth suppression; leaf-fall; reduction in yield	0.3 0.05	8 hours season
Nitrogen dioxide (NO_2)	High-temperature combustion of gasoline, oil, gas, and coal in internal combustion engines and power plants; manufacture of acids	Dead spots between veins and on margins of leaves	2.5 0.5	4 hours season
Hydrogen fluoride (HF)	Phosphate rock processing; aluminum refining; iron smelting; brick and ceramic works; fiber glass manufacturing	Dead tip and margin of leaves; yellowing of leaves; leaf-fall; dwarfing; lower yield	0.0001	5 weeks
Chlorine (Cl_2)	Leaks in chlorine storage tanks; hydrochloric acid mist	Bleaching between veins and dead tip and margin of leaves; defoliation	0.10	2 hours
Ethylene (CH_2)	Automobile and truck exhaust; incomplete combustion of coal, gas, and oil; chemical manufacture	Yellowing of leaves; leaf-fall; failure of flower to open; flower dropping; stimulation of lateral growth	0.05	6 hours
Ozone (O_3)	Photochemical reaction of hydrocarbons and nitrogen oxides from fuel combustion (esp. in automobiles); refuse burning; and evaporation from petroleum products and organic solvents	Flecks and bleached spots on leaves; early leaf-fall; growth suppression	0.03	4 hours
Peroxyacetyl nitrate (PAN)	Same sources as ozone	Discoloration (silvering or bronzing) on undersurface of young leaves	0.01	6 hours

Source: Detwyler, 1972.

chlorophyll and other pigments; enzyme inactivation; alterations of amino acid composition; altered respiration rates; influence on the control of stomatal openings; and possible mutagenic effects. Dry particulates deposited on plant surfaces appear to affect plants by reducing the level of sunlight reaching plant cells.

Combinations of two or more pollutants often produce synergistic effects. All well defined instances of synergistic effects have involved sulfur dioxide. Combinations of sulfur dioxide and ozone and of sulfur dioxide and nitrogen dioxide almost always yield synergistic or additive effects (Reinert, Heagle and Heck, 1975; Applegate and Durrant, 1969; Tingey, Reinert, Dunning and Heck, 1971, 1973; White, Hill and Bennett, 1974). Combinations of sulfur dioxide and hydrogen fluoride tend to show synergistic effects at low dosages, and either additive or antagonistic effects at higher dosages (Reinert, Heagle and Heck, 1975). Other combinations of air pollutants have received little study.

Exposure to air pollutants may increase the susceptibility of plants to temperature, water, or salinity stresses. On the other hand, some plant pathogens (especially fungi) are frequently more sensitive to certain air pollutants than is their host plant. Sulfur dioxide and certain fluoride compounds are especially toxic to many fungi. Ozone, on the other hand, is often more toxic to the host plant than it is to fungi or bacteria (Treshow, 1975). Bacteria appear to be generally insensitive to air pollutants at concentrations which damage plants (Heagle, 1973). Air pollution damage to vegetation often increases the susceptibility of plants to damage by insect pests (Heagle, 1973; Taylor, et.al., 1973).

Deposition of some particulates and acid precipitation have the potential for altering soil chemistry in ways which adversely affect some plants.

The extent of air pollution damage to vegetation in California is receiving increasing attention. In 1974, fluoride damage was reported from Alameda, Contra Costa, Marin, Monterey and Riverside Counties; sulfur dioxide damage was reported from Contra Costa and Sonoma Counties; peroxyacyl nitrate damage was reported from Butte, Placer, Riverside, San Bernardino, San Diego, Santa Barbara, Sutter, and Ventura Counties; and ozone damage was reported from Alameda, Contra Costa, El Dorado, Orange, Riverside, San Bernardino, San Diego, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, and Ventura Counties, as well as throughout the San Joaquin Valley.

The economic value of air pollution damage to agricultural crops in California has been estimated at $100-132 million per year (Environmental Science and Technology, 1970; Hindawi, 1970) when the economic value of reduced crop yields are considered. Millecan (1976), however, has estimated the value of crop damage in California at $16.1 million for 1970, $19.1 million for 1971, $17.4 million for 1972, $35.2 million for 1973, and $55.1 million for 1974. These values do not completely account for reductions in crop yields, and do not include the value of losses attributable to crop changes forced by air pollution levels. The 1970-74 increase in crop damage primarily reflects increasing crop values, not more extensive damage.

Behavioral and Psychological Effects

The effects of air pollution on people's behavior and attitudes has received little study. Possible effects include increased incidences of psychosomatic illness and personality changes induced by discomfort due to irritating or other health effects of air pollution, noxious odors, etc. On the other hand, increased levels of light-scattering aerosols can produce intense sunsets and sunrises.

APPENDIX A-2

AIR QUALITY MONITORING PROBLEMS

Photochemical Oxidants

Several methods of monitoring ambient levels of ozone and other oxidants have been developed during the last two decades. Instruments based on potassium oxide (KI), ultraviolet photometry and chemoluminescence have been accepted as the preferred methods, with the KI method being the most widely used. The KI instrument consists of pumps and meters for sampling air and metering reagent, a contact column for absorging oxidants in the KI reagent, a calorimeter for measuring iodine released from the reagent, and a strip chart recorder to record oxidant concentration. The instrument is normally calibrated against a known ozone mixture and bubblers containing KI reagent.

The Los Angeles Air Pollution Control District (LAAPCD), San Diego Air Pollution Control District, U. S. Environmental Protection Agency (EPA), and California Air Resources Board (ARB) have all used slightly different procedures for calibrating their KI instruments. Except for the LAAPCD and the San Diego APCD, local air pollution control districts in California have used the ARB calibration procedures. Until recently, these different calibration procedures were assumed to yield comparable results. Comparison tests conducted in 1973 and 1974 revealed that the EPA and ARB procedures (using 1 and per percent neutral buffered KI reagent, respectively) produced oxidant readings which were about 30 percent higher than those given by the LAAPCD.

In August 1974, the ARB appointed a special Oxidant Measurement Committee to review the situation and recommend appropriate action. Tests conducted by this committee confirmed the differences among the EPA, ARB and LAAPCD calibration procedures and also produced evidence that all three procedures were sensitive to changes in relative humidity. The committee recommended that a new calibration procedure be adopted utilizing an ultraviolet photometry method. The new calibration procedure, adopted by the ARB on May 15, 1975, produces an oxidant reading 22 percent lower than that given by the former ARB method, 15 percent lower than the San Diego APCD method, and 4 percent higher than that given by the LAAPCD method. Based on these data, the California Air Resources Board has adopted the following correction factors to be applied to pre-June 1975 data: LAAPCD data - 1.0; San Diego APCD data - 0.85; ARB stations and all other APCD data - 0.8. EPA has also accepted these values as correction factors.

As a result of the instrument calibration problems described above, the AIR Quality Advisory Committee to the California Department of Health undertook a review of the basis for the air pollution emergency episode criteria levels for oxidant. As a result of this review, the ARB lowered the "warning" and "emergency" episode criteria from 40 and 60 pphm to 35 and 50 pphm, respectively. Neither the ARB nor EPA has initiated a similar review of the basis for the existing state and federal oxidant standards.

Lead Particulates

The California Air quality standard for lead (1.5 $\mu g/m^3$ as a 30-day average) is based largely on studies utilizing millipore filters for sampling, direct acid extraction (wet ashing method) for sample preparation, and the dithizone method for determining lead content. Use of fiberglass filters for sample collection or atomic absorption spectroscopy for lead content determination has been shown to produce equivalent results.

Prior to 1975, many local air pollution control districts used a cellulose rather than a fiberglass filter paper (because older types of fiberglass filter paper were contaminated with various heavy metals). In addition, some agencies used a high temperature, dry ashing method rather than the wet ashing method to separate the lead from the filter paper.

Recent comparison studies have shown that use of collulose filters and the wet ashing method produces results which are about 50 percent below those produced by the approved analytical method. Use of cellulose filters and dry ashing produces results about 65 percent below those of the approved method. Beginning in 1975, all local air pollution control districts will be using approved analytical methods. The ARB has established correction factors of 1.3 and 2.92 for converting results of the cellulose filter-wet ashing method and cellulose filter-dry ashing method, respectively, to values consistent with the approved analytical methods. Lead analyses of particulate samples from Salinas, Hollister and Watsonville have been performed using approved methodologies and thus require no correction (Malone, pers. comm.).

APPENDIX A-3

AVERAGE DAILY AIR POLLUTANT EMISSIONS, 1971-74

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AVERAGE EMISSIONS OF AIR POLLUTA
MONTEREY, SANTA CRUZ COUNTIES - 1971
Tons Per Day

03-27-72/73

MICROFILMED

EMISSION SOURCES	ORGANIC COMPOUNDS			PARTICULATE MATTER			OXIDES OF NITROGEN			SULFUR DIOXIDE			CARBON MONOXIDE		
	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total
PETROLEUM															
Production	3.4	-	3.4	1.0	-	1.0	4.4	-	4.4	15.1	-	15.1	-	-	-
Marketing	3.0	1.0	4.0	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	6.4	1.0	7.4	1.0	-	1.0	4.4	-	4.4	15.1	-	15.1	-	-	-
ORGANIC SOLVENTS															
Surface Coating	2.5	1.2	3.7	0.1	-	0.1	-	-	-	-	-	-	-	-	-
Dry Cleaning	0.9	0.5	1.4	-	-	-	-	-	-	-	-	-	-	-	-
Degreasing	3.2	1.5	4.7	-	-	-	-	-	-	-	-	-	-	-	-
Other	1.5	0.5	2.0	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	8.1	3.7	11.8	0.1	-	0.1	-	-	-	-	-	-	-	-	-
METALLURGICAL															
Metallurgical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MINERAL															
Asphalt Batching	-	-	-	0.1	0.1	0.2	-	-	-	-	-	-	-	-	-
Cement	-	-	-	-	2.0	2.0	-	-	-	-	-	-	-	-	-
Dolomite and Magnesia	-	-	-	5.4	-	5.4	-	-	-	-	-	-	-	-	-
Concrete Batching	-	-	-	0.1	-	0.1	-	-	-	-	-	-	-	-	-
Other	-	-	-	0.2	0.1	0.3	-	-	-	-	-	-	-	-	-
SUBTOTAL	-	-	-	5.8	2.2	8.0	-	-	-	-	-	-	-	-	-
INCINERATION															
Open Burning Dumps	0.1	-	0.1	-	-	-	-	-	-	-	-	-	0.2	0.1	0.3
Backyard Burning	5.4	3.3	8.7	2.2	1.3	3.5	1.5	0.9	2.4	-	-	-	11.7	7.0	18.7
Incinerators	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.3	1.0
SUBTOTAL	5.5	3.3	8.8	2.2	1.3	3.5	1.5	0.9	2.4	-	-	-	12.6	7.4	20.0
COMBUSTION OF FUELS															
Natural Gas															
Steam Power Plants	1.6	-	1.6	1.8	-	1.8	13.9	-	13.9	0.1	-	0.1	-	-	-
Other Industrial	0.1	-	0.1	0.3	0.1	0.4	3.0	1.0	4.0	-	-	-	-	-	-
Domestic & Commercial	-	-	-	0.3	0.1	0.4	1.6	0.8	2.4	-	-	-	-	-	-
Fuel Oil															
Steam Power Plants	-	-	-	0.1	-	0.1	2.3	-	2.3	1.7	-	1.7	-	-	-
Other	-	-	-	-	-	-	0.1	-	0.1	0.1	0.1	0.2	-	-	-
SUBTOTAL	1.7	-	1.7	2.5	0.2	2.7	20.9	1.8	22.7	1.9	0.1	2.0	-	-	-
AGRICULTURE															
Debris Burning	1.0	0.4	1.4	0.7	0.3	1.0	0.1	-	0.1	-	-	-	2.4	0.9	3.3
Orchard Heaters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Product Processing	-	-	-	3.0	0.1	3.1	-	-	-	--	-	-	-	-	-
Pesticides	13.7	0.5	14.2	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	14.7	0.9	15.6	3.7	0.4	4.1	0.1	-	0.1	-	-	-	2.4	0.9	3.3
LUMBERING & WOOD PRODUCTS															
Lumbering & Wood Products	-	0.3	0.3	0.1	0.4	0.5	-	-	-	-	-	-	-	1.6	1.6
TOTAL STATIONARY SOURCES	36.4	9.2	45.6	15.4	4.5	19.9	26.9	2.7	29.6	17.0	0.1	17.1	15.0	9.9	24.9
MOTOR VEHICLES															
Gasoline Powered															
Exhaust	34.1	21.1	55.2	1.9	1.2	3.1	22.8	14.1	36.9	1.1	0.7	1.8	260.0	169.0	429.0
Blow by	3.0	1.9	4.9	-	-	-	-	-	-	-	-	-	-	-	-
Evaporation	13.3	8.3	21.6	-	-	-	-	-	-	-	-	-	-	-	-
Diesel Powered	1.2	0.7	1.9	0.4	0.2	0.6	5.2	3.2	8.4	0.4	0.2	0.6	5.0	3.1	8.1
SUBTOTAL	51.6	32.0	83.6	2.3	1.4	3.7	28.0	17.3	45.3	1.5	0.9	2.4	265.0	172.1	437.1
AIRCRAFT															
Jet Driven	0.1	-	0.1	0.1	-	0.1	0.1	-	0.1	-	-	-	0.1	-	0.1
Piston Driven	0.6	0.1	0.7	0.2	-	0.2	0.6	-	0.6	-	-	-	12.0	0.8	12.8
SUBTOTAL	0.7	0.1	0.8	0.3	-	0.3	0.7	-	0.7	-	-	-	12.1	0.8	12.9
SHIPS AND RAILROADS															
Ships and Railroads	0.5	0.3	0.8	0.2	0.1	0.3	0.6	0.4	1.0	0.4	0.2	0.6	0.6	-	0.6
TOTAL MOBILE SOURCES	52.8	32.4	85.2	2.8	1.5	4.3	29.3	17.7	47.0	1.9	1.1	3.0	277.7	172.9	450.6
GRAND TOTAL	89.2	41.6	130.8	18.2	6.0	24.2	56.2	20.4	76.6	18.9	1.2	20.1	292.7	182.8	475.5
Percent from Mobile Sources	59	78	65	15	25	18	52	87	61	10	92	15	95	95	95

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NOTE: Organic compound emissions from petroleum production at San Ardo not included.

Source: Monterey-Santa Cruz County Unified Air Pollution Control District, 1972.

APR 4 1973

03-27-73/74

AVERAGE EMISSIONS OF AIR POLLUTANTS
MONTEREY, SANTA CRUZ COUNTIES - 1972
Tons Per Day

EMISSION SOURCES	ORGANIC COMPOUNDS			PARTICULATE MATTER			OXIDES OF NITROGEN			SULFUR DIOXIDE			CARBON MONOXIDE		
	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total
PETROLEUM															
Production	3.4	-	3.4	1.7	-	1.7	5.8	-	5.8	26.0	-	26.0	-	-	-
Marketing	3.0	1.0	4.0	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	6.4	1.0	7.4	1.7	-	1.7	5.8	-	5.8	26.0	-	26.0	-	-	-
ORGANIC SOLVENTS															
Surface Coating	2.5	1.2	3.7	0.1	-	0.1	-	-	-	-	-	-	-	-	-
Dry Cleaning	0.9	0.5	1.4	-	-	-	-	-	-	-	-	-	-	-	-
Degreasing	3.2	1.5	4.7	-	-	-	-	-	-	-	-	-	-	-	-
Other	1.5	0.5	2.0	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	8.1	3.7	11.8	0.1	-	0.1	-	-	-	-	-	-	-	-	-
METALLURGICAL															
Metallurgical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MINERAL															
Asphalt Batching	-	-	-	0.1	0.1	0.2	-	-	-	-	-	-	-	-	-
Cement	-	-	-	-	1.5	1.5	-	-	-	-	-	-	-	-	-
Dolomite and Magnesia	-	-	-	2.6	-	2.6	-	-	-	-	-	-	-	-	-
Concrete Batching	-	-	-	0.1		0.1	-	-	-	-	-	-	-	-	-
Other	-	-	-	0.4	0.4	0.8	-	-	-	-	-	-	-	-	-
SUBTOTAL	-	-	-	3.2	2.0	5.2	-	-	-	-	-	-	-	-	-
INCINERATION															
Open Burning Dumps	0.1	-	0.1	-	-	-	-	-	-	-	-	-	0.2	0.1	0.3
Backyard Burning	5.4	3.3	8.7	2.2	1.3	3.5	1.5	0.9	2.4	-	-	-	11.7	7.0	18.7
Incinerators	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.3	1.0
SUBTOTAL	5.5	3.3	8.8	2.2	1.3	3.5	1.5	0.9	2.4	-	-	-	12.6	7.4	20 0
COMBUSTION OF FUELS															
Natural Gas															
Steam Power Plants	1.6	-	1.6	1.8	-	1.8	16.0	-	16.0	0.1	-	0.1	10.0	-	10.0
Other Industrial	0.1	-	0.1	0.3	0.1	0.4	6.0	1.0	7.0	-	-	-	10.0	-	10.0
Domestic & Commercial	-	-	-	0.3	0.1	0.4	2.1	0.8	2.9	-	-	-	-	-	-
Fuel Oil															
Steam Power Plants	0.1	-	0.1	0.5	-	0.5	5.1	-	5.1	3.6	-	3.6	-	-	-
Other	-	-	-	-	-	-	0.1	0.1	0.2	0.1	0.1	0.2	-	-	-
SUBTOTAL	1.8	-	1.8	2.9	0.2	3.1	29.3	1.9	31.2	3.8	0.1	3.9	20.0	-	20.0
AGRICULTURE															
Debris Burning	1.0	0.4	1.4	0.7	0.3	1.0	0.1	-	0.1	-	-	-	2.4	0.9	3.3
Orchard Heaters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Product Processing	-	-	-	1.7	0.1	1.8	-	-	-	-	-	-	-	-	-
Pesticides	13.7	0.5	14.2	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	14.7	0.9	15.6	2.4	0.4	2.8	0.1	-	0.1	-	-	-	2.4	0.9	3.3
LUMBERING & WOOD PRODUCTS															
Lumbering & Wood Products	-	0.1	0.1	-	0.2	0.2	-	-	-	-	-	-	-	0.5	0.5
TOTAL STATIONARY SOURCES	36.5	9.0	45.5	12.5	4.1	16.6	36.7	2.8	39.5	29.8	0.1	29.9	35.0	8.8	43.8
MOTOR VEHICLES															
Gasoline Powered															
Light Duty	29.8	18.7	48.5	1.3	0.8	2.1	17.8	9.3	27.1	0.7	0.4	1.1	170.0	106.0	276.0
Heavy Duty	22.8	15.6	38.4	0.9	0.6	1.5	8.5	5.3	13.8	0.5	0.3	0.8	99.0	62.0	161.0
SUBTOTAL	52.6	34.3	86.9	2.2	1.4	3.6	26.3	14.6	40.9	1.2	0.7	1.9	269.0	168.0	437.0
Diesel Powered															
On-Highway	0.4	0.3	0.7	0.1	0.1	0.2	3.7	2.3	6.0	0.2	0.2	0.4	2.3	1.4	3.7
Off-Highway	0.1	0.1	0.2	-	-	-	0.7	0.5	1.2	-	-	-	0.5	0.3	0.8
SUBTOTAL	0.5	0.4	0.9	0.1	0.1	0.2	4.4	2.8	7.2	0.2	0.2	0.4	2.8	1.7	4.5
TOTAL MOTOR VEHICLES	53.1	34.7	87.8	2.3	1.5	3.8	30.7	17.4	48.1	1.4	0.9	2.3	271.8	169.7	441.5
AIRCRAFT															
Jet Powered	0.1	-	0.1	0.1	-	0.1	0.1	-	0.1	-	-	-	0.1	-	0.1
Piston Engine	0.6	0.1	0.7	0.2	-	0.2	0.6	--	0.6	-	-	-	12.0	0.8	12.8
SUBTOTAL	0.7	0.1	0.8	0.3	-	0.3	0.7	-	0.7	-	-	-	12.1	0.8	12.9
RAILROADS	0.5	0.3	0.8	0.2	0.1	0.3	0.6	0.4	1.0	0.4	0.2	0.6	0.6	-	0.6
TOTAL MOBILE SOURCES	54.3	35.1	89.4	2.8	1.6	4.4	32.0	17.8	49.8	1.8	1.1	2.9	284.5	170.5	455.0
GRAND TOTAL	90.8	44.1	134.9	15.3	5.7	21.0	68.7	20.6	89.3	31.6	1.2	32.8	319.5	179.3	498.8
PERCENT															
Stationary Sources	40	20	34	82	72	79	53	14	44	94	8	91	11	90	9
Mobile Sources	60	80	66	18	28	21	47	86	56	6	92	9	89	10	91

NOTE: Organic compound emissions from petroleum production at San Ardo not included.

Source: Monterey-Santa Cruz County Unified Air Pollution Control District, 1973.

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AVERAGE EMISSIONS OF AIR POLLUTANTS
MONTEREY, SANTA CRUZ COUNTIES - 1973
Tons Per Day

EMISSION SOURCES	ORGANIC COMPOUNDS			PARTICULATE MATTER			OXIDES OF NITROGEN			SULFUR DIOXIDE			CARBON MONOXIDE		
	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total	Monterey	Santa Cruz	Total
PETROLEUM															
Production	0.3	-	0.3	2.4	-	2.4	8.6	-	8.6	33.9	-	33.9	0.5	-	0.5
Marketing	3.2	1.4	4.6	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	3.5	1.4	4.9	2.4	-	2.4	8.6	-	8.6	33.9	-	33.9	0.5	-	0.5
ORGANIC SOLVENTS															
Surface Coating	2.6	1.4	4.0	0.1	-	0.1	-	-	-	-	-	-	-	-	-
Dry Cleaning	0.9	0.5	1.4	-	-	-	-	-	-	-	-	-	-	-	-
Degreasing	1.8	1.0	2.8	-	-	-	-	-	-	-	-	-	-	-	-
Other	7.9	0.5	8.4	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	13.2	3.4	16.6	0.1	-	0.1	-	-	-	-	-	-	-	-	-
METALLURGICAL															
Metallurgical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MINERAL															
Asphalt Batching	-	-	-	0.1	0.1	0.2	-	-	-	-	-	-	-	-	-
Cement	-	-	-	-	1.5	1.5	-	-	-	-	-	-	-	-	-
Dolomite and Magnesia	-	-	-	2.0	-	2.0	-	-	-	1.7	-	1.7	-	-	-
Concrete Batching	-	-	-	0.1	-	0.1	-	-	-	-	-	-	-	-	-
Other	-	-	-	0.2	0.2	0.4	-	-	-	-	-	-	-	-	-
SUBTOTAL	-	-	-	2.4	1.8	4.2	-	-	-	1.7	-	1.7	-	-	-
INCINERATION															
Open Burning Dumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Backyard Burning	6.5	3.5	10.0	0.6	0.4	1.0	-	-	-	-	-	-	14.3	7.7	22.0
Incinerators	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.3	1.0
SUBTOTAL	6.5	3.5	10.0	0.6	0.4	1.0	-	-	-	-	-	-	15.0	8.0	23.0
COMBUSTION OF FUELS															
Natural Gas															
Steam Power Plants	0.1	-	0.1	1.3	-	1.3	18.0	-	18.0	0.1	-	0.1	8.4	-	8.4
Other Industrial	0.1	-	0.1	0.5	0.1	0.6	9.8	0.3	10.1	-	-	-	10.6	0.1	10.7
Domestic & Commercial	0.1	0.1	0.2	0.3	0.1	0.4	1.5	0.7	2.2	-	-	-	0.3	0.2	0.5
Fuel Oil															
Steam Power Plants	0.3	-	0.3	1.2	-	1.2	6.5	-	6.5	9.6	-	9.6	0.5	-	0.5
Other	-	-	-	-	-	-	-	-	-	-	0.1	0.1	-	-	-
SUBTOTAL	0.6	0.1	0.7	3.3	0.2	3.5	35.8	1.0	36.8	9.7	0.1	9.8	19.8	0.3	20.1
AGRICULTURE															
Debris Burning	1.0	0.4	1.4	0.7	0.3	1.0	0.1	-	0.1	-	-	-	2.4	0.9	3.3
Orchard Heaters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Product Processing	-	-	-	1.1	0.1	1.2	0.8		-	-	-	-	0.1	-	0.1
Pesticides	10.2	1.0	11.2	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	11.2	1.4	12.6	1.8	0.4	2.2	0.9	-	0.9	-	-	-	2.5	0.9	3.4
LUMBERING & WOOD PRODUCTS															
Lumbering & Wood Products	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL STATIONARY SOURCES	35.0	9.8	44.8	10.6	2.8	13.4	45.3	1.0	46.3	45.3	0.1	45.4	37.8	9.2	47.0
MOTOR VEHICLES															
Light Duty Vehicle	23.7	15.5	39.2	1.5	0.8	2.3	20.6	13.5	34.1	0.9	0.6	1.5	175.0	116.0	291.0
Heavy Duty Gasoline	7.6	5.1	12.7	0.3	0.2	0.5	3.6	2.3	5.9	0.1	0.1	0.2	46.4	30.4	76.8
Heavy Duty Diesel	0.8	0.5	1.3	0.3	0.2	0.5	3.6	2.3	5.9	0.3	0.2	0.5	3.4	2.2	5.6
Motorcycle	0.7	0.4	1.1	-	-	-	-	-	-	-	-	-	2.8	1.8	4.6
Evaporation	5.5	3.6	9.1	-	-	-	-	-	-	-	-	-	-	-	-
Crankcase	0.2	0.1	0.3	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	38.4	25.2	63.6	2.1	1.2	3.3	27.8	18.1	45.9	1.3	0.9	2.2	227.6	150.4	378.0
JET AIRCRAFT	0.2	-	0.2	0.2	-	0.2	0.2	-	0.2	-	-	-	0.2	-	0.2
PISTON AIRCRAFT	0.5	0.2	0.7	-	-	-	0.9	-	0.9	-	-	-	18.0	-	18.0
RAILROADS	0.8	-	0.8	0.2	-	0.2	2.9	-	2.9	0.4	-	0.4	1.0	-	1.0
SHIPS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER OFF ROAD VEHICLES	2.8	1.0	3.8	0.4	1.0	1.4	4.5	1.6	6.1	0.7	2.0	2.7	28.7	19.6	48.3
TOTAL MOBILE SOURCES	42.7	26.4	69.1	2.9	2.2	5.1	36.3	19.7	55.0	2.4	2.9	5.3	275.5	170.0	445.5
GRAND TOTAL	77.7	36.2	113.9	13.5	5.0	18.5	81.6	20.7	102.3	47.7	3.0	50.7	313.3	179.2	492.5
PERCENT															
Stationary Sources	45.0	27.0	39.3	78.5	56.0	72.4	55.5	4.8	45.3	95.0	3.3	90.0	12.0	5.1	9.5
Mobile Sources	55.0	73.0	60.7	21.5	44.0	27.6	44.5	95.2	54.7	5.0	96.7	10.0	88.0	94.9	90.5

NOTE: Organic compound emissions from petroleum production at San Ardo not included.
Source: Monterey-Santa Cruz County Unified Air Pollution Control District, 1974.

AVERAGE EMISSIONS OF AIR POLLUTANTS

MONTEREY, SANTA CRUZ AND SAN BENITO COUNTIES 1974

Tons Per Day

EMISSION SOURCES	ORGANIC COMPOUNDS				PARTICULATE MATTER				OXIDES OF NITROGEN				SULFUR DIOXIDE				CARBON MONOXIDE			
	Monterey	Santa Cruz	San Benito	Total	Monterey	Santa Cruz	San Benito	Total	Monterey	Santa Cruz	San Benito	Total	Monterey	Santa Cruz	San Benito	Total	Monterey	Santa Cruz	San Benito	Total
PETROLEUM																				
Production	118.1	-	-	118.1	3.0	-	-	3.0	10.5	-	-	10.5	34.8	-	-	34.8	0.5	-	-	0.5
Marketing	3.2	1.4	0.4	5.0	-	-	-	-	10.5	-	-	10.5	-	-	-	-	-	-	-	-
SUBTOTAL	121.3	1.4	0.4	123.1	3.0	-	-	3.0	10.5	-	-	10.5	34.8	-	-	34.8	0.5	-	-	0.5
ORGANIC SOLVENTS																				
Surface Coating	2.6	1.4	0.2	4.2	0.1	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-
Dry Cleaning	0.9	0.5	0.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Degreasing	1.8	1.0	0.1	2.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	3.1	0.5	0.2	3.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	8.4	3.4	0.6	12.4	0.1	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-
METALLURGICAL																				
Metallurgical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MINERAL																				
Asphalt Batching	-	-	-	-	0.1	0.1	0.2	0.4	-	-	-	-	-	-	-	-	-	-	-	-
Cement	-	-	-	-	-	1.5	-	1.5	-	-	-	-	-	-	-	-	-	-	-	-
Dolomite & Magnesia	-	-	-	-	1.9	-	0.1	2.0	-	-	-	-	1.0	-	-	1.0	-	-	-	-
Concrete Batching	-	-	-	-	0.1	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	0.2	0.2	0.1	0.5	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	-	-	-	-	2.3	1.8	0.4	4.5	-	-	-	-	1.0	-	-	1.0	-	-	-	-
INCINERATION																				
Open Burning Dumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Backyard Burning	3.8	2.0	0.3	6.1	0.3	0.2	-	0.5	-	-	-	-	-	-	-	-	8.3	4.5	0.6	13.4
Incinerators	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.3	-	1.0
SUBTOTAL	3.8	2.0	0.3	6.1	0.3	0.2	-	0.5	-	-	-	-	-	-	-	-	9.0	4.8	0.6	14.4
COMBUSTION OF FUELS																				
Natural Gas																				
Steam Power Plants	0.1	-	-	0.1	0.7	-	-	0.7	9.5	-	-	9.5	0.1	-	-	0.1	4.4	-	-	4.4
Other Industrial	0.1	-	-	0.1	0.5	0.1	-	0.6	9.8	0.3	-	10.1	-	-	-	-	10.6	0.1	-	10.7
Domestic & Commercial	0.1	0.1	-	0.2	0.3	0.1	-	0.4	1.5	0.7	0.1	2.3	-	-	-	-	0.3	0.2	-	0.5
Fuel Oil																				
Steam Power Plants	0.4	-	-	0.4	1.4	-	-	1.4	7.9	-	-	7.9	11.6	-	-	11.6	0.6	-	-	0.6
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	0.1	-	-	-	-
SUBTOTAL	0.7	0.1	-	0.8	2.9	0.2	-	3.1	28.7	1.0	0.1	29.8	11.7	0.1	-	11.8	15.9	0.3	-	16.2
AGRICULTURAL																				
Debris Burning	1.0	0.4	0.1	1.5	0.7	0.3	0.1	1.1	0.1	-	-	0.1	-	-	-	-	2.4	0.9	0.2	3.5
Product Processing	-	-	-	-	1.1	0.1	0.1	1.3	0.8	-	-	0.8	-	-	-	-	0.1	-	-	0.1
Pesticides	3.3	0.3	0.3	3.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	4.3	0.7	0.4	5.4	1.8	0.4	0.2	2.4	0.9	-	-	0.9	-	-	-	-	2.5	0.9	0.2	3.6
LUMBERING & WOOD PRODUCTS																				
Lumbering & Wood Products	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL STATIONARY SOURCES	138.5	7.6	3.7	147.8	10.4	2.6	0.6	13.6	40.1	1.0	0.1	41.2	47.5	0.1	-	47.6	27.9	6.0	0.8	34.7
MOTOR VEHICLES																				
Light Duty Vehicle	17.5	11.3	1.3	30.1	1.5	1.0	0.1	2.6	16.4	10.7	1.2	28.3	0.4	0.3	-	0.7	169.2	109.8	12.2	291.2
Heavy Duty Gasoline	7.6	5.1	0.9	13.6	0.3	0.2	-	0.5	3.6	2.3	0.4	6.3	0.1	0.1	-	0.2	46.4	30.4	5.7	82.5
Heavy Duty Diesel	0.8	0.5	0.1	1.4	0.3	0.2	-	0.5	3.6	2.3	0.4	6.3	0.3	0.2	-	0.5	3.4	2.2	0.4	6.0
Motorcycle	0.7	0.4	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-	2.8	1.8	0.2	4.8
Evaporation	8.7	5.6	0.6	14.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crankcase	0.2	0.1	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	35.5	23.0	2.9	61.4	2.1	1.4	0.1	3.6	23.6	15.3	2.0	40.9	0.8	0.6	-	1.4	221.8	144.2	18.5	384.5
JET AIRCRAFT	0.2	-	-	0.2	0.2	-	-	0.2	0.2	-	-	0.2	-	-	-	-	0.2	-	-	0.2
PISTON AIRCRAFT	0.5	0.2	-	0.7	-	-	-	-	0.9	-	-	0.9	-	-	-	-	18.0	-	-	18.0
RAILROADS	0.8	-	-	0.8	0.2	-	-	0.2	2.9	-	-	2.9	0.4	-	-	0.4	1.0	-	-	1.0
SHIPS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER OFF ROAD VEHICLES	2.8	1.0	0.8	4.6	0.4	1.0	-	1.4	4.5	1.6	1.0	7.1	0.7	2.0	-	2.7	28.7	19.6	8.6	56.9
TOTAL MOBILE SOURCES	39.8	24.2	3.7	67.7	2.9	2.4	0.1	5.4	32.1	16.9	3.0	52.0	1.9	2.6	-	4.5	269.7	163.8	27.1	460.6
GRAND TOTAL	178.3	31.8	5.4	215.5	13.3	5.0	0.7	19.0	72.2	17.9	3.1	93.2	49.4	2.7	-	52.1	297.6	169.8	27.9	495.3
PERCENT																				
Stationary Sources	77.7	24.6	31.5	68.7	78.2	52.0	85.7	71.6	55.5	5.6	3.3	44.7	96.1	3.7	-	91.2	9.7	3.9	3.2	7.4
Mobile Sources	22.3	75.4	68.5	31.3	21.8	48.0	14.3	28.4	44.5	94.4	96.7	55.3	3.9	96.3	-	8.8	90.3	96.1	96.8	92.6

Source: Monterey Bay Unified Air Pollution Control District, 1975.

AVERAGE EMISSIONS OF POLLUTANTS- 1973
NORTH CENTRAL COAST AIR BASIN

AUGUST 2, 1976 TONS PER DAY 1 OF 2

STATIONARY SOURCES	ROG	TOG	PART.	NOX	SO2	CO
PETROLEUM						
PRODUCTION	57.2	107				
REFINING						
MARKETING	5.0	5.2				
SUBTOTAL	62.3	112				
ORGANIC SOLVENT USERS						
SURFACE COATING	3.8	4.2	0.1			
DRY CLEANING		1.5				
DEGREASING	0.3	2.9				
OTHER	6.1	8.4				
SUBTOTAL	10.2	17.0	0.1			
CHEMICAL						
METALLURGICAL			0.2		0.6	
MINERAL			13.4		1.7	
FOOD AND AG PROCESSING			2.6			
PESTICIDES	3.0	3.0				
WOOD PROCESSING						
COMBUSTION OF FUELS						
POWER PLANTS	0.2	0.4	2.5	24.5	9.7	8.9
OTHER INDUSTRIAL	0.2	0.6	3.2	20.6	34.1	11.1
DOMESTIC AND COMMERCIAL	0.2	0.5	0.5	2.4		0.5
ORCHARD HEATERS	5.0	5.1	1.8		0.3	
SUBTOTAL	5.6	6.6	8.0	47.5	44.1	20.5
WASTE BURNING						
AGRICULTURAL DEBRIS	1.0	2.0	1.0			2.6
FOREST MANAGEMENT						
RANGE IMPROVEMENT	0.5	0.9	0.4			1.4
DUMPS						
CONICAL BURNERS						
INCINERATORS						0.7
OTHER	5.3	10.2	1.2			21.5
SUBTOTAL	6.8	13.1	2.6			26.2
MISCELLANEOUS AREA SOURCES						
WILD FIRES	0.3	0.6	0.4			2.0
STRUCTURAL FIRES	0.6	1.2	0.8			3.8
FARMING OPERATIONS			14.9			
CONSTR. AND DEMOL.			0.9			
UNPAVED ROADS			3.8			
UTILITY EQUIP:MOWERS,ETC	0.6	0.7				5.4
SUBTOTAL	1.6	2.5	20.8			11.2
TOTAL,STATIONARY	89.4	154	47.7	47.5	46.4	57.9

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AVERAGE EMISSIONS OF POLLUTANTS- 1973
NORTH CENTRAL COAST AIR BASIN

AUGUST 2, 1976

TONS PER DAY

2 OF 2

MOBILE SOURCES	ROG	TOG	PART.	NOX	SO2	CO
MOTOR VEHICLES-ON ROAD						
LIGHT-DUTY VEHICLE EXH	19.4	21.9	3.1	25.5	0.7	230
MED & HEAVY-DUTY VEH EXH	5.0	5.6	0.4	3.9	0.1	48.8
HEAVY-DUTY DIESEL EXH	0.7	0.7	0.5	7.2	0.8	5.2
MOTORCYCLE EXH	0.4	0.5				2.4
EVAPORATION	12.8	13.3				
CRANKCASE	1.0	1.1				
SUBTOTAL	39.4	43.1	4.0	36.6	1.6	286
JET AIRCRAFT	0.2	0.2	0.2	0.2		0.2
PISTON AIRCRAFT	0.7	0.8		0.9		19.8
RAILROADS	0.8	0.8	2.0	2.8	0.4	1.0
SHIPS						
OTHER OFF-ROAD VEH	4.2	4.7	1.6	7.8	3.2	61.1
TOTAL MOBILE SOURCES	45.3	49.6	7.8	48.3	5.2	368
TOTAL, ALL SOURCES	135	204	55.5	95.8	51.6	426

AVERAGE EMISSIONS OF POLLUTANTS- 1973
MONTEREY COUNTY
NORTH CENTRAL COAST AIR BASIN

AUGUST 2, 1976 TONS PER DAY 1 OF 2

STATIONARY SOURCES	ROG	TOG	PART.	NOX	SO2	CO
PETROLEUM						
PRODUCTION	57.2	107				
REFINING						
MARKETING	3.2	3.3				
SUBTOTAL	60.4	110				
ORGANIC SOLVENT USERS						
SURFACE COATING	2.4	2.6	0.1			
DRY CLEANING		0.9				
DEGREASING	0.3	1.8				
OTHER	5.8	7.9				
SUBTOTAL	8.4	13.2	0.1			
CHEMICAL						
METALLURGICAL						
MINERAL			2.4		1.7	
FOOD AND AG PROCESSING			1.7			
PESTICIDES	1.2	1.2				
WOOD PROCESSING						
COMBUSTION OF FUELS						
POWER PLANTS	0.2	0.4	2.5	24.5	9.7	8.9
OTHER INDUSTRIAL	0.2	0.5	3.0	18.4	33.9	11.1
DOMESTIC AND COMMERCIAL	0.1	0.3	0.3	1.5		0.3
ORCHARD HEATERS						
SUBTOTAL	0.5	1.2	5.8	44.4	43.6	20.3
WASTE BURNING						
AGRICULTURAL DEBRIS	0.3	0.5	0.2			0.8
FOREST MANAGEMENT						
RANGE IMPROVEMENT	0.4	0.7	0.3			1.1
DUMPS						
CONICAL BURNERS						
INCINERATORS						0.7
OTHER	3.4	6.5	0.6			14.3
SUBTOTAL	4.0	7.7	1.1			16.9
MISCELLANEOUS AREA SOURCES						
WILD FIRES	0.2	0.3	0.2			1.0
STRUCTURAL FIRES	0.4	0.7	0.5			2.3
FARMING OPERATIONS			12.7			
CONSTR. AND DEMOL.			0.2			
UNPAVED ROADS			1.8			
UTILITY EQUIP:MOWERS,ETC	0.4	0.5				3.4
SUBTOTAL	1.0	1.5	15.4			6.7
TOTAL,STATIONARY	75.5	135	26.5	44.4	45.3	43.9

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AVERAGE EMISSIONS OF POLLUTANTS- 1973
MONTEREY COUNTY
NORTH CENTRAL COAST AIR BASIN

AUGUST 2, 1976 TONS PER DAY 2 OF 2

MOBILE SOURCES	ROG	TOG	PART.	NOX	SO2	CO
MOTOR VEHICLES-ON ROAD						
LIGHT-DUTY VEHICLE EXH	11.2	12.6	1.8	14.7	0.4	132
MED & HEAVY-DUTY VEH EXH	2.7	3.0	0.2	2.1	0.1	26.4
HEAVY-DUTY DIESEL EXH	0.4	0.4	0.3	3.9	0.4	2.8
MOTORCYCLE EXH	0.3	0.3				1.3
EVAPORATION	7.3	7.6				
CRANKCASE	0.6	0.6				
SUBTOTAL	22.4	24.5	2.3	20.7	0.9	163
JET AIRCRAFT	0.2	0.2	0.2	0.2		0.2
PISTON AIRCRAFT	0.4	0.5		0.9		18.0
RAILROADS	0.8	0.8	2.0	2.8	0.4	1.0
SHIPS						
OTHER OFF-ROAD VEH	2.6	2.9	0.4	4.7	0.8	29.5
TOTAL MOBILE SOURCES	26.4	28.9	4.9	29.3	2.1	211
TOTAL,ALL SOURCES	102	164	31.4	73.7	47.4	255

Source: California Air Resources Board, 1976c.

APPENDIX A-4

AMBIENT AIR QUALITY DATA

AMBIENT AIR QUALITY DATA: OXIDANTS
(parts per hundred million, by volume)

Station	Year	Annual Mean Hourly Concentration	Mean of Daily Maximum Concentration	Mean of Monthly Maximum Concentration	Maximum Hourly Concentration Measured
Carmel-Valley	1973	—	—	7.3	12
	1974	3.2	4.5	7.7	13
Gonzales-High School	1970	2.3	4.3	8.1	11
	1971	2.4	4.5	8.1	15
	1972	2.6	4.8	8.7	15
	1973	3.0	4.6	9.5	16
	1974	2.4	4.3	7.6	12
Hollister	1973	—	5.0	10.4	13
	1974	—	5.4	10.4	14
Monterey	1970	2.4	3.9	6.8	10
	1971	2.3	3.7	6.9	17
	1972	2.4	3.7	6.7	11
	1973	2.9	4.0	8.8	14
	1974	2.6	4.4	7.2	14
Salinas-Alisal	1970	2.4	3.9	7.2	11
	1971	2.5	4.1	7.0	10
	1972	2.5	4.2	6.9	9
	1973	2.8	4.1	9.0	15
	1974	2.7	4.5	8.0	12
Santa Cruz	1970	1.7	3.2	5.7	9
	1971	1.7	3.4	6.9	18
	1972	1.9	3.5	7.0	10
	1973	2.0	3.6	7.8	12
	1974	1.9	4.0	6.8	12
Watsonville-Trailer	1972	2.4	4.7	8.7	12
	1973	—	—	6.3	7

NOTES:

Carmel station began operating October 1973, but reported no data during July and August 1974.

Gonzales station reported no data during February 1971.

Hollister station operated May through December 1973 and August through December 1974.

Monterey station reported no data during January 1971.

Salinas station reported no data during January and February 1971.

Watsonville station operated July 1972 through April 1973.

Values listed have not been corrected for recent changes in analytical methods (see Appendix A-2).

AMBIENT AIR QUALITY DATA: CARBON MONOXIDE (CO)
(parts per million, by volume)

Station	Year	Annual Mean Hourly Concentration	Mean of Daily Maximum Concentration	Mean of Monthly Maximum Concentration	Maximum Hourly Concentration Measured
Monterey	1970	1.6	3.6	9.6	17
	1971	1.5	3.5	8.0	13
	1972	1.5	3.3	7.9	12
	1973	1.6	3.0	8.3	13
	1974	1.5	3.0	7.8	16
Salinas-Alisal	1974	2.6	3.2	6.5	13
Watsonville-Trailer	1972	1.7	2.7	4.8	6
	1973	—	—	4.7	7

NOTES:

Watsonville station operated from September 1972 through March 1973.

Monterey station reported no data during March, April and most of June and July 1973.

AMBIENT AIR QUALITY DATA: NITROGEN DIOXIDE (NO_2)
(parts per hundred million, by volume)

Station	Year	Annual Mean Hourly Concentration	Mean of Daily Maximum Concentration	Mean of Monthly Maximum Concentration	Maximum Hourly Concentration Measured
Hollister	1973	—	2.1	5.3	8
	1974	—	3.4	8.2	11
Monterey	1970	2.0	3.6	8.0	12
	1971	1.8	3.2	7.9	15
	1972	1.7	2.9	6.4	11
	1973	1.7	2.6	6.8	12
	1974	1.4	2.2	5.2	9
Salinas-Alisal	1970	2.4	4.1	7.6	10
	1971	2.5	4.3	7.8	11
	1972	2.4	4.2	8.8	11
	1973	2.3	3.7	7.7	14
	1974	2.1	3.6	8.3	15
Santa Cruz	1970	1.4	2.4	4.1	6
	1971	1.5	2.6	4.9	9
	1972	1.9	3.6	8.0	14
	1973	1.4	2.1	5.5	9
	1974	1.3	2.3	4.9	8
Watsonville-Trailer	1972	1.6	3.0	7.8	13
	1973	—	—	5.3	6

NOTES:

Hollister station operated May 1973 through January 1974 and August through December 1974.
Monterey station reported no data during January 1971.
Salinas station reported no data during January or February 1971.
Watsonville station operated July 1972 through March 1973.

AMBIENT AIR QUALITY DATA: NITRIC OXIDE (NO)
(parts per hundred million, by volume)

Station	Year	Annual Mean Hourly Concentration	Mean of Daily Maximum Concentration	Mean of Monthly Maximum Concentration	Maximum Hourly Concentration Measured
Hollister	1973	—	0.4	3.6	6
	1974	—	2.0	6.2	10
Monterey	1970	0.8	3.7	15.5	37
	1971	1.1	5.1	18.1	38
	1972	1.2	5.4	18.8	35
	1973	1.6	5.9	21.1	40
	1974	1.1	5.3	19.9	53
Salinas-Alisal	1970	2.2	8.4	27.3	42
	1971	1.7	7.0	19.1	44
	1972	1.3	6.0	21.1	50
	1973	1.5	5.3	18.9	38
	1974	1.0	4.8	20.4	34
Watsonville-Trailer	1972	0.3	1.7	7.2	9
	1973	—	—	3.7	6

NOTES:

Hollister station operated May 1973 through January 1974 and August through December 1974.
Monterey station reported no data during May 1970 and January 1971.
Salinas station reported no data March through May 1970 and January through February 1971.
Watsonville station operated July 1972 through May 1973.

AMBIENT AIR QUALITY DATA: OXIDES OF NITROGEN
(parts per hundred million, by volume)

Station	Year	Annual Mean Hourly Concentration	Mean of Daily Maximum Concentration	Mean of Monthly Maximum Concentration	Maximum Hourly Concentration Measured
Hollister	1973	—	2.6	5.8	8
	1974	—	5.1	10.6	19
Monterey	1970	2.8	6.8	21.9	40
	1971	2.9	7.6	20.8	42
	1972	2.8	7.8	22.8	38
	1973	3.3	7.8	26.2	46
	1974	2.5	7.2	22.9	59
Salinas-Alisal	1970	4.6	11.8	31.9	46
	1971	4.2	10.4	23.4	48
	1972	3.7	9.5	26.1	55
	1973	3.8	8.6	22.9	41
	1974	3.1	8.0	25.0	40
Watsonville-Trailer	1972	1.8	4.1	10.3	14
	1973	—	—	6.3	9

NOTES:

Hollister station operated May 1973 through January 1974 and August through December 1974.
Monterey station reported no data during May 1970 and January 1971.
Salinas station reported no data during March through May 1970 and January through February 1971.
Watsonville station operated July 1972 through March 1973.

AMBIENT AIR QUALITY DATA: HYDROCARBONS
(parts per million, by volume)

Station	Year	Annual Mean Hourly Concentration	Mean of Daily Maximum Concentration	Mean of Monthly Maximum Concentration	Maximum Hourly Concentration Measured
Hollister	1973	—	2.1	4.6	7
Monterey	1970	2.7	3.7	5.5	7
Salinas-Alisal	1970	2.7	3.6	7.5	13
	1971	2.7	3.7	6.2	12
	1972	2.6	3.5	5.9	10
	1973	2.8	2.9	5.8	12
	1974	3.4	4.4	7.5	18
Watsonville-Trailer	1972	2.3	2.8	4.7	6
	1973	—	—	3.5	3

NOTES:

Hollister station operated May through December 1973.
Monterey station operated January through April 1970.
Salinas station operated July through December 1970.
Watsonville station operated July 1972 through February 1973.

SOURCES: California Air Resources Board, 1974e.
California Air Resources Board, 1970-1975.
Monterey-Santa Cruz County Unified Air Pollution Control District, 1974.
Monterey Bay Unified Air Pollution Control District, 1975.

SULFUR COMPOUNDS (TOTAL SULFATION)
(milligrams $SO_3/dm^2/day$ by alkaline plate method)

Station	Year	Annual Average	Daily Average for Peak Month	Daily Average for Lowest Month
Davenport	1972	0.058	0.156	0.003
	1973	0.031	0.082	0.001
	1974	0.025	0.057	0.002
Hollister	1974	0.014	0.039	0.002
Monterey	1972	0.006	0.014	0.001
	1973	0.011	0.066	0.001
	1974	0.009	0.019	0.001
Moss Landing-Dolan Ranch	1972	0.021	0.052	0.003
	1973	0.016	0.035	0.001
	1974	0.017	0.030	0.004
Moss Landing-Fire Station	1972	0.105	0.372	0.007
	1973	0.094	0.286	0.001
	1974	0.067	0.182	0.025
Salinas-Alisal	1972	0.031	0.077	0.010
	1973	0.020	0.035	0.005
	1974	0.020	0.052	0.002
San Ardo-Main Street	1972	0.089	0.251	0.019
	1973	0.100	0.393	0.010
	1974		0.347	0.031
San Ardo-Mobil Oil Co.	1972	0.917	1.885	0.132
	1973	0.790	1.900	0.087
San Ardo-Mobil #102	1974	0.539	1.077	0.194
San Ardo-Mobil #198	1974	0.364	0.904	0.077
San Ardo-Mobil #223	1974	0.321	0.697	0.125
San Ardo-Texaco	1972	0.417	0.816	0.139
	1973	0.371	0.678	0.015
San Ardo-Texaco #209	1974	0.552	1.057	0.239
San Ardo-Texaco #226	1974	1.806	3.484	0.280
San Ardo-Texaco #268	1974	1.603	2.522	0.140
Watsonville-Hospital	1972	0.007	0.019	0.001
Watsonville-PG&E	1973	0.010	0.052	0.001
	1974	0.009	0.016	0.001

NOTES:

Davenport station reported no data for May 1973.
Monterey station reported no data for February, May or July 1972.
Salinas station reported no data for July 1972.
San Ardo-Main Street station began operating in May 1972.
San Ardo-Mobil Oil Co. station reported no data for August 1972.
San Ardo-Mobil #102 and #223 stations began operating in March 1974.
San Ardo-Texaco #209 and #268 stations reported no data for January 1974.
San Ardo-Texaco #226 station reported no data for December 1974.
Watsonville-Hospital station reported no data during January, February or December 1972.

Sources: Monterey-Santa Cruz County Unified Air Pollution Control District, 1973, 1974.
Monterey Bay Unified Air Pollution Control District, 1975.

LEAD PARTICULATES
(micrograms per cubic meter, $\mu g/m^3$)

Station	Year	Annual Mean of Monthly Averages	Highest Monthly Average	Lowest Monthly Average
Hollister	1973	0.20	0.32	0.09
Salinas-Alisal	1973	0.43	0.82	0.22
	1974	0.49	0.97	0.20
Watsonville	1972	0.29	0.43	0.19
	1973	----	0.38	0.17

NOTES:

Values listed above were determined by approved analytical methods (see Appendix A-2).

Hollister station operated during May through December 1973.
Salinas station began operating in July 1973.
Watsonville station operated from July 1972 through May 1973.

Source: California Air Resources Board, 1970-1975.

TOTAL SUSPENDED PARTICULATES
(micrograms per cubic meter, $\mu g/m^3$, by Hi-Volume Method)

Station	Year	Annual Geometric Mean	Maximum 24-Hour Value	Percent of 24-Hour Samples Equaling or Exceeding 100/$\mu g/m^3$	Percent of 24-Hour Samples Exceeding 150 $\mu g/m^3$
Gonzales	1970	61	134	27	0
	1971	75	211	25	8
	1972	58	157	18	4
	1973	49	159	19	3
	1974	41	94	0	0
Hollister	1974	53	97	0	0
King City	1970	53	112	8	0
	1971	61	156	17	4
	1972	63	160	17	4
	1973	51	133	11	0
Monterey	1970	36	85	0	0
	1971	34	88	0	0
	1972	32	60	0	0
	1973	33	90	0	0
	1974	28	57	0	0
Salinas-Alisal	1970	67	141	26	0
	1971	66	207	25	5
	1972	74	255	23	5
	1973	83	563	35	22
	1974	74	156	28	2
Salinas-Natividad Road	1974	55	94	0	0
Santa Cruz	1970	46	131	5	0
	1971	40	73	0	0
	1972	44	78	0	0
	1973	52	103	10	0
	1974	55	111	10	0
Watsonville-Hospital	1972	47	86	0	0
Watsonville-Trailer	1972	59	142	15	0
	1973	--	75	0	0
Watsonville-PG&E	1973	76	192	21	3
	1974	58	115	8	0

Sources: California Air Resources Board, 1974e.
California Air Resources Board, 1970-1975.
Monterey-Santa Cruz County Unified Air Pollution Control District, 1974.
Monterey Bay Unified Air Pollution Control District, 1975.

SUSPENDED PARTICULATES (COEFFICIENT OF HAZE [COH] VALUE BY AISI METHOD)

Station	Year	Annual Mean of 2-Hour COH Values	Mean of Monthly Highest Daily Average COH Values	Mean of Monthly Maximum 2-Hour COH Values	Maximum 2-Hour COH Value Measured
Gonzales	1970	0.26	0.44	0.80	1.2
	1971	0.25	0.35	0.87	1.4
	1972	0.22	0.34	0.71	1.0
	1973	0.15	0.29	0.57	0.9
	1974	0.13	0.22	0.48	0.7
Hollister	1973	----	0.34	0.71	1.2
Monterey	1970	0.25	0.38	0.88	1.4
	1971	0.23	0.31	0.69	1.4
	1972	0.21	0.31	0.70	1.4
	1973	0.13	0.21	0.77	2.4
	1974	0.14	0.21	0.64	1.0
Salinas-Alisal	1970	0.30	0.56	1.17	1.8
	1971	0.31	0.49	1.05	1.6
	1972	0.31	0.51	1.2	2.0
	1973	0.23	0.34	0.92	1.5
	1974	0.13	0.21	0.53	0.8
Salinas-Natividad Road	1970	0.24	0.36	0.69	0.9
	1971	0.24	0.33	0.72	1.5
	1972	0.21	0.29	0.65	1.2
Santa Cruz	1970	0.24	0.35	1.15	2.4
	1971	0.23	0.30	0.61	1.4
	1972	0.22	0.30	0.98	2.0
	1973	0.22	0.31	0.68	1.2
	1974	0.12	0.22	0.53	1.1
Watsonville-Hospital	1972	0.27	0.47	2.21	5.0
Watsonville-Trailer	1972	0.21	0.46	1.18	1.9
	1973	----	----	0.63	0.9
Watsonville-PG&E	1973	0.20	0.29	0.63	1.1
	1974	0.19	0.33	0.79	1.7

NOTES:

Gonzales station reported no data during May 1970.
Hollister station operated July through December 1973.
Monterey station began operating in July 1970.
Salinas-Alisal station reported no data during January and February 1970.
Salinas-Natividad Road station reported no data during March through May 1970 and December 1972.
Santa Cruz station reported no data during January and February 1970.
Watsonville-Hospital station operated March through November 1972.
Watsonville-Trailer station operated August 1972 through March 1973.
Watsonville-PG&E station began operating in February 1973.

COH values have been classified in a Soiling Index as follows:

COH Units	Range of Soiling
0.0 - 0.9	Light soiling
1.0 - 1.9	Moderate soiling
2.0 - 2.9	Heavy soiling
3.0 - 3.9	Very heavy soiling
4.0 +	Extremely heavy soiling

Sources: California Air Resources Board, 1974e.
California Air Resources Board, 1970-1975.
Monterey-Santa Cruz County Unified Air Pollution Control District, 1974.
Monterey Bay Unified Air Pollution Control District, 1975.

APPENDIX A-5

FEBRUARY 1976 PROJECTION OF AIR QUALITY IN MONTEREY COUNTY

Emissions Forecasts

Estimates of the quantities of various air pollutants which will be generated in the future are essential for any estimate of future ambient air quality. Table I presents estimates of average daily air pollutant emissions by source category for 1985 and 1995. These emission projections were prepared with minor modifications of the procedures described in California Air Resources Board, 1974c.

Emissions calculations for most stationary sources involved multiplying emissions for a base year (from Appendix A-3) by an appropriate growth factor. Growth factors for use with 1972 base data are presented in Exhibit A. In several cases, a year other than 1972 was selected as being the most appropriate base year, and growth factors from Exhibit A were modified accordingly. The selection of an appropriate base year was made by comparing the emission inventories for 1972-74 and related discussions of inventory techniques and source control programs in the annual reports of the local Air Pollution Control District. Emissions from power plants and mobile sources were estimated by a variety of techniques as described in more detail below.

Reactive hydrocarbon emissions were estimated for major source categories using 1972 statewide proportionality factors as presented in California Air Resources Board, 1974a. Exhibit B illustrates these factors and applies them to the 1971-74 emission inventory data.

Total hydrocarbon emissions from the San Ardo oil fields were calculated separately from other petroleum production sources. The steam injection wells at this field were recently recognized as a major source of hydrocarbon emissions. Recently implemented control procedures are expected to be at least 98 percent effective (Abercrombie, pers. comm.).

Future emissions from the Moss Landing power plant were the most difficult source to project. Power generation at this facility will fluctuate according to the availability of power from hydroelectric and nuclear generating plants. Fuel oil is expected to become the exclusive fuel at this facility by 1980 (Exhibit C). In the absence of other figures, 1985 power generation at Moss Landing was assumed to be 8 million megawatt-hours; 1995 generation was assumed to be 11 million megawatt-hours. These values were combined with emission factors presented in Exhibit D to produce estimated power plant emissions.

Projected motor vehicle emissions for hydrocarbons, nitrogen oxides and carbon monoxide are based on weighted composite emission factors presented in Exhibit E and on adjusted projections of average daily vehicle miles of travel (VMT). The Monterey County Transportation Study (MCTS) projected 1995 VMT levels based on a county population somewhat higher than the California Department of Finance D-100 projections. Since emissions from several source categories were calculated as proportional to the D-100 population projections, the 1995 VMT projections from MCTS were adjusted to a D-100 population base. An average daily VMT value for 1985 was estimated as proportional to the relative population increase (1973 to 1985 period as compared to the 1973-1995 period). VMT values used were: 1973 VMT -- 5,068,697; extrapolated 1985 VMT -- 7,191,960; adjusted 1995 VMT -- 9,156,798. Emissions of sulfur oxides and particulates were assumed to be proportional to changes in VMT, with 1973 used as a base year.

Projected aircraft emissions utilized weighted composite emission factors (Exhibit F) and a proportionality equation given in California Air Resources Board, 1974c.

$$E_{fy} = E_{by} \times \frac{P_{fy}}{P_{by}} \times \frac{EF_{fy}}{EF_{by}}$$

E Emissions (tons/day)
P Population (D-100 projections)
EF Emission Factor (Exhibit F)
by Base year (1973, with 1975 emission factors assumed applicable to 1973)
fy Future year

Table I

PROJECTED EMISSIONS OF AIR POLLUTANTS IN MONTEREY COUNTY BY SOURCE CATEGORY

Source	Base Year	Growth Factor	Projected 1985 Emissions, Tons Per Day					
			Hydrocarbons		Nitrogen Oxides	Sulfur Oxides	Carbon Monoxide	Particulate
			Total	Reactive				
Petroleum Industries								
Production	1972	1.52	8.65	2.43	15.23	50.46	0.73	4.35
Marketing	1972	1.29	3.87	1.09				
Solvent Users								
Surface Coatings	1972	2.03	5.08	0.85				0.20
Dry Cleaning	1972	1.29	1.16	0.20				
Degreasing	1973	2.03	3.65	0.62				
Other	1974	1.26	3.91	0.66				
Minerals Industries	1974	1.12				1.12		2.58
Food Processing	1974	1.45			1.16	1.16	0.11	1.60
Pesticides	1974	1.09	3.60	2.86				
Combustion of Fuels								
Power Plants	NA	NA	2.24	0.74	31.92	58.88	0.81	3.42
Other Industrial	1972	2.03	0.20	0.03	12.38	0.20	20.30	0.61
Domestic and Commercial	1974	1.29	0.13	0.02	1.94		0.39	0.39
Waste Burning								
Agricultural Debris	1972	1.15	1.15	0.14	0.12		2.76	0.81
Incinerators	1972	1.29					0.90	
Other	1972	1.29			0.13	0.13		
TOTAL STATIONARY			33.64	9.64	62.88	111.95	26.00	13.96
Motor Vehicles	1973	NA	11.81	8.86	12.60	1.84	141.19	2.98
Trains, Off-Road Vehicles	1973	1.28	4.61	3.45	9.47	1.41	38.01	0.77
Aircraft	1973	NA	0.62	0.37	1.20		14.85	0.20
TOTAL MOBILE			17.04	12.68	23.27	3.25	194.05	3.95
TOTAL EMISSIONS			50.68	22.32	86.15	115.20	220.05	17.91

Table I (Continued)

Source	Base Year	Growth Factor	Projected 1995 Emissions, Tons Per Day					
			Hydrocarbons		Nitrogen Oxides	Sulfur Oxides	Carbon Monoxide	Particulate
			Total	Reactive				
Petroleum Industries								
Production	1972	1.92	10.93	3.07	19.43	64.38	0.93	5.55
Marketing	1972	1.55	4.65	1.31				
Solvent Users								
Surface Coatings	1972	3.30	8.25	1.39				0.33
Dry Cleaning	1972	1.55	1.40	0.23				
Degreasing	1973	3.30	5.94	1.00				
Other	1974	1.52	4.71	0.79				
Minerals Industries	1974	1.50				1.50		3.45
Food Processing	1974	2.04			1.63	1.63	0.20	2.24
Pesticides	1974	1.18	3.89	3.10				
Combustion of Fuels								
Power Plants	NA	NA	3.08	1.02	43.89	80.96	1.11	4.71
Other Industrial	1972	3.30	0.33	0.06	20.13	0.33	33.0	0.99
Domestic and Commercial	1974	1.55	0.16	0.03	2.33		0.47	0.47
Waste Burning								
Agricultural Debris	1972	1.25	1.25	0.15	0.13		3.0	0.88
Incinerators	1972	1.55					1.09	
Other	1972	1.55			0.16	0.16		
TOTAL STATIONARY			44.59	12.15	87.70	148.96	39.80	18.62
Motor Vehicles	1973	NA	9.08	6.81	12.11	2.35	159.38	3.79
Trains, Off-Road Vehicles	1973	1.54	5.54	4.15	11.39	1.69	45.70	0.92
Aircraft	1973	NA	0.41	0.24	1.19		7.70	0.18
TOTAL MOBILE			15.03	11.20	24.69	4.04	212.78	4.89
TOTAL EMISSIONS			59.62	23.35	112.39	153.0	252.58	23.51

NOTE: See accompanying text for discussion of methodology.

Sources: Derived from data in Monterey-San Cruz County Unified Air Pollution Control District, 1973, 1974; Monterey Bay Unified Air Pollution Control District, 1975; California Air Resources Board, 1973b, 1974a, 1974c and 1974d; California Department of Transportation, 1975b; Gruen Gruen + Associates, 1975a; O. N. Ford, 1975; K. H. Huston, 1975; and J. Abercrombie, pers. comm.

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EXHIBIT A

GROWTH FACTORS FOR ESTIMATING FUTURE YEAR STATIONARY SOURCE EMISSIONS

MONTEREY COUNTY - Salinas, Monterey Standard Metropolitan Statistical Area

EMISSION SOURCES-GROWTH INDICATOR CATEGORY (Total Earnings Index)	GROWTH FACTORS 1972	1975	1985	1995
PETROLEUM				
Production - (Mining-crude petroleum & natural gas)	100	110	152	192
Refining - (Manufacturing-petroleum refinining)	100	100	100	100
Marketing - (Population^2)	100	106	129	155
ORGANIC SOLVENT USERS				
Surface Coating - (Manufacturing-composite index)	100	122	203	330
Dry Cleaning - (Population^2)	100	106	129	155
Degreasing - (Manufacturing-composite index)	100	122	203	330
Other - (Population^2)	100	106	129	155
CHEMICAL - (Manufacturing-chemical and allied products)	100	124	201	327
METALLURGICAL - (Manufacturing-primary metals)	100	-	-	-
MINERAL - (Mining metal or non-metallic, except fuels)	100	98	116	155
FOOD AND AGRICULTURAL PROCESSING - (Manufacturing food&kindred products)	100	112	160	224
PESTICIDES - (Agriculture-composite index)	100	109	115	125
WOOD PROCESSING - (Manufacturing-lumber products and furniture)	100	134	179	247
COMBUSTION OF FUELS				
Power Plants^3	100	-	-	-
Other Industrial - (Manufacturing-composite index)	100	122	203	330
Domestic and Commercial - (Population^2)	100	106	129	155
Orchard Heaters - (Agriculture-composite index)	100	109	115	125
WASTE BURNING				
Agricultural Debris - (Agriculture-composite index)	100	109	115	125
Forest Management - (Forest and Fisheries)	100	119	178	238
Range Improvement - (Agriculture-composite index)	100	109	115	125
Dumps^4	100	-	-	-
Conical Burners - (Manufacturing-lumber products and furniture)	100	134	179	247
Incinerators - (Population^2)	100	106	129	155
Other - (Population^2)	100	106	129	155
MISCELLANEOUS AREA SOURCES				
Wild Fires - (Population^2)	100	106	129	155
Structural Fires - (Population^2)	100	106	129	155
Farming Operations - (Agriculture-composite index)	100	109	115	125
Construction and Demolition - (Contract Construction)	100	132	221	360
Unpaved Roads - (Population^2)	100	106	129	155
Other - (Population^2)	100	106	129	155

[1] Based on total earnings projections from "Population and Economic Activity in the United States and Standard Metropolitan Statistical Areas, Historical and Projected 1950-2020," Bureau of Economic Analysis, United States Department of Commerce. July, 1972. PB 216 207.

[2] Population growth factors based on projections of California Department of Finance, D-100 series. January 10, 1974.

[3] Special study - Please refer to section on Fossil Fuel Electric Generating Plants.

[4] Enforcement activities by ARB should eliminate this source by 1975; future emissions are assumed negligible.

Source: California Air Resources Board, 1974c.

EXHIBIT B

REACTIVE HYDROCARBON EMISSIONS IN MONTEREY COUNTY
(tons per day)

Source	Reactive Hydrocarbons as % of Total Hydrocarbons	1971	1972	1973	1974
Petroleum Industries	29.125	34.93	34.93	34.12	34.12
Organic Solvent Users	16.842	1.36	1.36	2.22	1.41
Mineral Industries	1.515	0	0	0	0
Food Processing	0.714	0	0	0	0
Pesticides	79.487	10.89	10.89	8.11	2.62
Combustion of Fuels	16.923	0.288	0.305	0.102	0.118
Waste Burning	12.222	0.794	0.794	0.917	0.587
TOTAL STATIONARY		48.262	48.279	45.469	38.855
Motor Vehicles	75.00	38.7	39.75	28.8	26.63
Jet aircraft	46.154	0.046	0.046	0.092	0.092
Piston Aircraft	74.545	0.447	0.447	0.373	0.373
Trains	74.286	0.371	0.371	0.594	0.594
Off-Highway Vehicles	75.000		0.075	2.10	2.10
TOTAL MOBILE		39.564	40.689	31.959	29.789
TOTAL EMISSIONS		87.826	88.968	77.428	68.644

NOTE: 1971-1973 values for petroleum industries adjusted to reflect previously undetected hydrocarbon emissions at the San Ardo oil fields (117.8 tons per day, total hydrocarbons).

Sources: California Air Resources Board, 1974a; Monterey-Santa Cruz County Unified Air Pollution Control District, 1972, 1973, 1974; Monterey Bay Unified Air Pollution Control District, 1975.

PACIFIC GAS AND ELECTRIC COMPANY

COPY

EXHIBIT C

October 6, 1975

Mr. Mark Said
Gruen Gruen & Associates
564 Howard Street
San Francisco, California 94105

Dear Mr. Said:

This is in response to your letter of September 15, 1975, regarding our Moss Landing Power Plant.

Attached is a sheet showing historic and current generation as well as fuel consumption. It is difficult to predict future generation due to the weather variables. In 1974 and 1975, considerable power was available from the Pacific Northwest. The higher than average precipitation in these years also made higher than average power available from our own hydroelectric plants. This accounts for the decline in total generation over 1972, a dry year. Also, in 1975 power was purchased from SMUD's Rancho Seco Nuclear Plant.

Natural gas is burned as a boiler fuel when available. We expect gas to be available only 25% of the time in 1976 and 17% of the time in 1977. Supplies will continue to decline until 1979 or 1980 when no gas will be available for power plant boiler fuel.

In mid 1976 Unit 1 of our Diablo Canyon Nuclear Power Plant will start production. This will reduce total generation at Moss Landing approximately 10% over 1975. In mid 1976 Unit 2 will start production. This should cause an approximate 25% reduction over 1975. By 1980 Moss Landing should be back to 1975 production.

The fuels burned at Moss Landing do not exceed .5% sulphur by weight. It is not anticipated that there will be any change in this requirement as long as adequate supplies of low sulphur fuel are available.

I hope this answers your questions; if not, please let me know.

Sincerely,

K. H. Huston
Executive Representative

KHH/bjm
Attach.
cc: Mr. Harold Bissell
Jones & Stokes Associates
455 Capitol Mall, Ste. 835
Sacramento, California 95814

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Generation and Fuel Burned, Moss Landing Power Plant

Year	Generation (MW)	Fuel	
		Gas, MCF	Oil, Bbls
Thru Aug 1975	5,449,922.05	28,507,645	3,051,700
1974	6,205,127,85	34,289,735	3,289,914
1973	9,557,681.40	65,088,838	2,708,850
1972	16,815,973.25	84,761,815	992,031
1971	9,052,118.50	77,354,187	528,187
1970	9,161,752,20	75,358,562	30,208

EXHIBIT D

Emission Factors for Emissions from Fossil Fuel Electric Generating Plant in Tons Per Day/Million MWH Per Year[1]

Pollutant	Fuel		
	Natural Gas	Fuel Oil	Coal[2]
Oxides of Nitrogen (NOx)	2.0	3.99	9.59
Particulate Matter	0.114	0.428	1.37
Sulfur Dioxide (SO_2)		14.72(S) where (S) represents sulfur content of fuel in percent by weight	16.44
Total Organic Gases	0.013	0.28	0.1712
Reactive Organic Gases	6% of total organic gas emissions	33% of total organic gas emissions	not known
Carbon Monoxide	Assumed negligible	Assumed negligible	0.57[3]

[1] From internal ARB report by Alan Goodley, Engineering Evaluation Unit, April 16, 1974.

[2] Provided by Alan Goodley, Engineering Evaluation Unit, June 25, 1974. Based on New Source Performance Standards promulgated by the Environmental Protection Agency.

[3] Based on data in [7]

Source: California Air Resources Board, 1974c.

EXHIBIT E

COMPOSITE EMISSION FACTORS USED IN CALCULATING MOTOR VEHICLE EMISSIONS IN MONTEREY COUNTY

Vehicle Type	Pollutant	Composite Emission Factors, CVS-2 Test Cycle (grams per mile)					VMT-Based Weighting Factor
		1972	1973	1975	1985	1995	
Light-duty, gasoline powered	Hydrocarbons	8.73	7.33	4.52	0.79	0.38	83.7%
	Carbon Monoxide	53.7	48.2	37.1	5.03	2.86	
	Oxides of Nitrogen	5.64	4.81	3.15	0.68	0.52	
Heavy-duty, gasoline powered	Hydrocarbons	24.26	21.89	17.14	7.44	5.20	10.2%
	Carbon Monoxide	187.8	169.4	132.7	126.3	124.8	
	Oxides of Nitrogen	9.16	9.09	8.95	4.60	3.29	
Heavy-duty, diesel powered	Hydrocarbons	3.53	3.34	2.97	1.04	0.8	5.3%
	Carbon Monoxide	21.21	20.47	19.0	12.7	12.0	
	Oxides of Nitrogen	30.63	30.32	29.7	10.36	8.0	
On-road motor-cycles	Hydrocarbons	10.62	10.62	10.62	1.29	0.66	0.9%
	Carbon Monoxide	34.9	34.9	34.9	4.47	3.4	
	Oxides of Nitrogen	0.16	0.16	0.16	0.58	0.4	
Weighted composite factors	Hydrocarbons	10.06	8.64	5.78	1.49	0.90	
	Carbon Monoxide	64.54	59.02	45.91	17.81	15.79	
	Oxides of Nitrogen	7.29	6.56	5.12	1.59	1.20	

NOTES AND SOURCES:

1975, 1985 and 1995 vehicle emission factors from California Air Resources Board, 1974c.

1972 vehicle emission factors derived from 1972 7-mode emission factors by using ratios derived from 1975 7-mode and CVS-2 emission factors as given in California Air Resources Board, 1973b and 1974c, respectively.

1973 vehicle emission factors derived by linear extrapolation from 1972 and 1975 CVS-2 values.

Weighting factors based on 1972 statewide averages as reported in California Air Resources Board, 1974c.

EXHIBIT F

COMPOSITE EMISSION FACTORS USED IN CALCULATING AIRCRAFT EMISSIONS IN MONTEREY COUNTY

Aircraft Type	Average No. of Engines	% of Total Operations		Resultant Weighting Factor		Aircraft Type	Average No. of Engines	% of Total Operations		Resultant Weighting Factor	
		1975	1995	1975	1995			1975	1995	1975	1995
Mid-Range Jet	2.5	6.61	9.74	0.16525	0.2435	Piston Transport	4	33.62	18.04	1.3448	0.7216
Commercial Turboprop	3	0.25	0.07	0.0075	0.0021	Helicopter	2	2.03	1.62	0.0406	0.0324
Business Jet	3	1.02	1.44	0.0306	0.0432	Military Transport	4	0.10	0.07	0.0040	0.0028
General Aviation Turboprop	2	0.81	0.72	0.0162	0.0144	Military Jet	2	1.02	0.72	0.0204	0.0144
General Aviation Piston	1	54.43	67.48	0.5443	0.6748	Military Piston	2	0.10	0.07	0.0020	0.0014

NOTES: Aircraft types and average number of engines from U. S. Environmental Protection Agency, 1975 . Percent of total operations based on incomplete data shown in Exhibit G.

	Year	Hydrocarbons		Carbon Monoxide	Oxides of Nitrogen	Sulfur Oxides	Particulates
		Total	Reactive				
Weighted composite emission factors (pounds per landing and take-off cycle)	1975	56.19	33.26	419.72	2.44	0.593	0.868
	1985	38.68	22.90	267.60	2.08	0.544	0.682
	1995	21.17	12.53	115.48	1.71	0.495	0.495

NOTES: Derived from weighting factors given above and emission factors given in Exhibit H. 1985 values interpolated.

EXHIBIT G

September 17, 1975

Mr. Harold Bissell
JONES & STOKES ASSOCIATES
455 Capitol Mall, Ste. 835
Sacramento, Ca. 95814

Dear Hal:

Roberta Mundie asked me to research Mike Rushton's questions regarding current and projected aircraft operations in both Monterey County and the study area. Unfortunately, none of the airports, with the possible exception of Monterey Peninsula Airport, break their operations into the desired level of detail. I have asked Mr. O. N. Ford, Manager of Monterey Peninsula Airport, to send you their information on current and projected aircraft operations. Mr. Ford wasn't sure whether or how the information was broken down. None of the other airports have projections of future operations.

In the enclosed table, I am presenting what sketchy information I have been able to gather. The data are based on telephone conversations with representatives of the three airfields listed, and they represent the closest approximations that the individuals cared to make. I have been unable to contact Mr. Peter Defino, Director of the small Carmel Valley Airport. Nevertheless, in a telephone conversation with Ernie Franco of the Monterey County Planning Department, I learned that Carmel Valley Airport currently has approximately 30 operations a month. According to Mr. Franco, only small, general utility planes land at Carmel Valley. Although Mr. Defino apparently would like to expand the operations of the airport, there is strong opposition to this from the surrounding community.

The King City Airport is also a small time operation. Thirty-five planes are stationed at the airport and it is seldom used by anyone else. The planes at King City are used mostly for crop dusting.

Gruen Gruen + Associates
564 Howard Street
San Francisco, Ca 94105
(415) 433-7598

The three airfields located in the study area are: Monterey Peninsula Airport, Salinas Airport and the airfield at Fort Ord. King City Airfield and Carmel Valley Airport are located within Monterey County, but outside of the study area.

I am also enclosing Chapter 8 of the 1970 Salinas-Monterey Area Transportation Study. This is a good statement of the air transportation problems and trends in the Monterey-Salinas area, at least as of 1970.

I hope the enclosed information is helpful in preparing the air quality portion of the EIS. If you have any questions, please contact me.

Very truly yours,

Mark Said

Mark Said
Economist

P.S. Here are some historical population figures for the study area.

MS:ps
Enc.

EXHIBIT G (Cont'd)

CURRENT AIRCRAFT OPERATIONS

	Salinas[1]	King City[2]	Fort Ord[3]
Long range jet	0	0	0
Mid range jet	0	0	0
Air carrier turboprop	0	0	0
Business jet	1%	occasional	0
Gen'l. aviation turboprop	1%	0	0
Gen'l. aviation piston	30-33%	most	0
Piston transport	60%	a few	0
Helicopter	3%	0	72-76 (Oct) 191[4]
Military transport		0	0
Military jet	1-2%		
Military piston	0		6-8%

---

[1] Based on telephone conversation with Mr. Gus Meiser, Salinas Airport, September 15, 1975.

[2] Based on telephone conversation with Mr. Lee Yarborough, King City Airport, September 15, 1975.

[3] Based on telephone conversation with Mr. Wilson, Public Information Officer at Fort Ord, September 16, 1975.

[4] In October, Fort Ord's function will change as it will become headquarters for the Seventh Division.

MONTEREY PENINSULA AIRPORT DISTRICT

BOARD OF DIRECTORS
TED DURFIN, CHAIRMAN • LOUIS V. SCHMIDT • RICHARD TOURANGEAU • JACK W. FLAHERTY • KEI NAKAMURA
EXECUTIVE STAFF
O. N. FORD, AIRPORT MANAGER • F. R. FULLER, ASSISTANT MANAGER • E. I. DUNNE, SECRETARY • L. L. FENTON, COUNSEL

September 23, 1975

Gruen Gruen & Associates
564 Howard Street
San Francisco, CA 94105

Attention: Mr. Mark Said

Dear Mr. Said:

In reply to your letter of September 16, 1975, the following information is transmitted. Your request for specifics was not detailed so the information has to be general in nature, and in some areas we do not hold the desired data.

*Annual Aircraft Operations:

	Present	Projected (1995)
Long Range Jet	none	none
Mid Range Jet	11,000	27,000
Air Carrier Turboprop	500	none
Business Jet	1,000	3,000
General Aviation Turboprop	500	1,000
General Aviation Piston	70,000	150,000
Piston Transport	100	none
Helicopter	200	500
Military Transport	200	200
Military Jet	100	100
Military Piston	50	none

*An operation by FAA definition is a landing or a takeoff.

Sincerely,

O. N. Ford

O. N. Ford
District Manager

ONF:rs

c.c: Mr. Harold Bissell

TELEPHONE (408) 373-3731 POST OFFICE BOX 550 MONTEREY, CALIFORNIA 93940

EXHIBIT H

EMISSION FACTORS PER AIRCRAFT LANDING-TAKEOFF CYCLE
(lb/engine)

Aircraft	Solid particulates		Sulfur oxides		Carbon monoxide		Hydrocarbons		Nitrogen oxides (NO_x as NO_2)	
	1975	1995	1975	1995	1975	1995	1975	1995	1975	1995
Jumbo jet	1.30	1.30	1.82	1.82	46.8	8.4	12.2	1.8	31.4	15.7
Long range jet	1.21	.61[a]	1.56	1.56	47.4	8.5	41.2	6.2	7.9	4.0
Medium range jet	0.41	.21[a]	1.01	1.01	17.0	3.1	4.9	0.74	10.2	5.1
Air carrier turboprop	1.1	1.1	0.40	0.40	6.6	2.6	2.9	0.58	2.5	2.0
Business jet	0.11	0.11	0.37	0.37	15.8	6.3	3.6	0.72	1.6	1.3
General aviation turboprop	0.20	0.20	0.18	0.18	3.1	1.2	1.1	0.22	1.2	1.0
General aviation piston	0.02	0.02	0.014	0.014	12.2	6.1	0.40	0.28	0.047	0.047
Piston transport	0.56	0.56	0.28	0.28	304.0	152.0	40.7	28.5	0.40	0.40
Helicopter	0.25	0.25	0.18	0.18	5.7	5.7	0.52	0.52	0.57	0.57
Military transport	1.1	1.1	0.41	0.41	5.7	5.7	2.7	2.7	2.2	2.2
Military jet	0.31	0.31	0.76	0.76	15.1	15.1	9.93	9.93	3.29	3.29
Military piston	0.28	0.28	0.14	0.14	152.0	152.0	20.4	20.4	0.20	0.20

1975 factors from AP-42, Compilation of Air Pollutant Emission Factors, Environmental Protection Agency, April 1973.

1995 factors are based on 1975 factors and the percentage reductions expected from implementation of the emission standards. [19]

[a] Assumed 50% reduction

Source: California Air Resources Board, 1974c.

Ambient Air Quality Projections

Due to the limitations of available data and air quality projection techniques, future ambient air quality in the study area is most appropriately analyzed at a countywide scale. Table II presents projections of potential future ambient air quality under adverse meteorological conditions similar to those occurring in the base year indicated. These estimates were calculated using countywide D-100 population projections because they most closely represent present population trends in Monterey County. The projection methodology was taken from _Introduction to Manual Methods for Estimating Air Quality_, prepared by the California Air Resources Board (1974).

As indicated in Table II, oxidant levels should show a significant improvement due to emission controls on new motor vehicles, gradual elimination of older vehicles, and improvements in stationary source emission controls. Nitrogen dioxide levels are expected to increase significantly, while particulate levels are expected to decrease for several years and then increase. Only the particulate levels are expected to exceed federal primary standards. There is insufficient data available to project sulfur dioxide levels.

Table II

PROJECTED AMBIENT AIR QUALITY IN MONTEREY COUNTY

Pollutant	Averaging Time	PROJECTED MAXIMUM VALUE			PROJECTED COUNTYWIDE MEAN OF MONTHLY MAXIMUM VALUES			FEDERAL STANDARDS		CALIFORNIA
		Base Year and Value	1985	1995	Base Year and Value	1985	1995	Primary	Secondary	Standard
Oxidant[1] (ppm)	1 hour	1973: 0.125	0.058	0.059	1973: 0.0675	0.042	0.042	0.08	0.08	0.10
Nitrogen Dioxide[2] (ppm)	1 hour	1974: 0.15	0.178	0.231	1972: 0.076	0.094	0.122	—	—	0.25
Carbon Monoxide (ppm)	1 hour	1974: 16.0	12.09	13.73	1973: 8.3	6.13	6.89	35	35	40
Particulates[3] ($\mu g/m^3$)	AGM 24 hours	1973: 83 1973:563	75.45 497.9	90.69 629.2	— —	— —	— —	75 260	60 150	60 100

NOTES AND SOURCES:

ppm	Parts per million by volume.
$\mu g/m^3$	Micrograms per cubic meter.
AGM	Annual geometric mean.
Formula	$AQ_{fy} = B + (AQ_{by} - B) \times \frac{E_{fy}}{E_{by}}$
AQ	Ambient air quality.
B	Natural background pollutant level.
E	Emissions.
fy	Future year.
by	Base year.

Formula and procedures described in California Air Resources Board, 1974d.

Background pollutant levels from California Air Resources Board, 1974a.

Historical emission levels given in Appendix A-3. Historical ambient air quality levels given in Appendix A-4.

[1] Calculations utilized reactive hydrocarbon emission levels. Values presented represent corrected levels (see Appendix A-2).

[2] Calculations utilized oxides of nitrogen emission levels.

[3] Emission levels corrected for photochemically generated aerosols as in California Air Resources Board, 1974c.

APPENDIX A-6

REACTIVITY CLASSIFICATION OF ORGANIC GAS EMISSIONS BY SOURCE CATEGORY

Source	Percentages by Class of Organic Gas Emissions		
	Class I	Class II	Class III
Petroleum			
Production	46.5	53.5	0.0
Refining	4.1	73.3	22.6
Marketing			
Terminal and Storage	5.7	70.0	24.3
Auto Tank Filling	2.3	67.4	30.3
Organic Solvent Users			
Surface Coating			
Heat Dried	3.7	28.0	68.3
Air Dried	9.2	53.4	37.4
Dry Cleaning			
Petroleum Based	0.0	94.3	5.7
Perchloroethylene	100.0	0.0	0.0
Degreasing			
Perchloroethylene or 1,1,1 - Trichloroethane	100.0	0.0	0.0
Trichloroethylene	0.0	0.0	100.0
Printing			
Rotogravure	6.0	69.0	25.0
Flexigraphic	15.0	10.0	75.0
Rubber, Plastic, Putty and Adhesive Mfg.	18.1	25.4	56.5
Pharmaceutical Mfg.	21.7	6.8	71.5
Misc. Organic Solvent Users	27.2	36.9	35.9
Chemical	0.0	0.0	100.0
Metallurgical	0.0	0.0	100.0
Mineral	66.2	10.3	23.5
Food and Agricultural Processing	0.0	0.0	100.0
Pesticides	0.0	30.0	70.0
Wood Processing	60.0	15.0	25.0
Combustion of Fuels			
Power Plants	2.6	53.1	44.3
Other Industrial	2.6	53.1	44.3
Domestic and Commercial Heaters	2.6	53.1	44.3
Orchard Heaters	2.6	53.1	44.3

Source	Percentages by Class of Organic Gas Emissions		
	Class I	Class II	Class III
Waste Burning			
Agricultural Debris	48.0	18.0	34.0
Forest Management	48.0	18.0	34.0
Range Improvement	48.0	18.0	34.0
Dumps	48.0	18.0	34.0
Conical Burners	48.0	18.0	34.0
Incinerators	48.0	18.0	34.0
Other Waste Burning	48.0	18.0	34.0
Miscellaneous Area Sources			
Wild Fires			
Structural Fires			
Utility Equip: Mowers, etc.	11.3	42.1	46.6
Gasoline Powered Vehicles			
Exhaust	11.3	42.1	46.6
Evaporative	3.5	56.4	40.1
Crankcase	7.2	49.7	43.1
Diesel Powered Vehicles	2.6	53.1	44.3
Aircraft			
Jet	2.0	47.6	50.4
Piston	14.4	41.4	44.2
Locomotives	2.6	53.1	44.3
Ships			
Steam	65.7	10.6	23.7
Diesel	2.6	53.1	44.3

Source: California Air Resources Board, 1976b.

APPENDIX A-7

SUPPORTING DATA FOR FEBRUARY 1977 PROJECTION OF FUTURE AIR QUALITY IN MONTEREY COUNTY

Background

The air quality implications of the proposed project have been examined in detail on three occasions during the preparation of this EIS. The first evaluation, completed in February 1976, has been presented in Appendix A-5. The results of the most recent evaluation are presented in the text of the EIS and in this appendix. The reasons for the repeated evaluation of air quality issues are discussed in the following paragraphs.

Several events in early 1976 necessitated a reanalysis of potential air quality problems in Monterey County. Subsequent to preparation of Appendix A-5, both EPA and ARB released significant revisions to their previous estimates of historical and projected motor vehicle emission rates (U. S. Environmental Protection Agency, 1976; California Air Resources Board, 1976b). ARB also adopted a revised hydrocarbon reactivity classification, resulting in significant revisions to previous estimates of the reactive fraction of hydrocarbon emissions from both stationary and mobile sources. Additionally, ARB revised its estimates of vehicles in use by county and average annual mileage by vehicle type. Revised VMT projections were released for the Monterey County Transportation study (California Department of Transportation, 1976) in April 1976.

Following preparation of Appendix A-5, questions were raised by ARB regarding the extent to which historical emissions of hydrocarbons at the San Ardo oil field may have influenced oxidant levels recorded in the Salinas and Monterey Bay areas. The state and federal oxidant standards were exceeded most frequently and to the greatest extent in 1973. Wind data for days in 1973 which had high oxidant levels are presented in Appendix B (Table B-4). In all but a few cases, winds at Salinas airport were from the northwest. While it is evident from the data in Appendix B that hydrocarbon emissions from the San Ardo oil fields will influence air quality in the Monterey and Salinas areas on a few days each year, most high oxidant days at both Monterey and Salinas (including the days with maximum oxidant levels) appear not to be influenced by the San Ardo emissions. Thus, the emissions and air quality projections in Appendix A-5 required revisions to exclude the current San Ardo emissions from consideration.

At the time Appendix A-5 was prepared, planning for the sizing and staging of the North Monterey County Facilities Plan was based on population projections prepared for the Monterey County Transportation Study (MCTS). Prior to the April 1976 revision, these MCTS projections were slightly higher than the California Department of Finance D-100 series population projections used as a basis for the analysis in Appendix A-5. During 1976, however, the design basis for facilities planning was changed to a composite of local agency population projections substantially exceeding the Department of Finance D-100 projections.

During late October and early November 1976, potential oxidant and nitrogen dioxide levels were reanalyzed on the basis of most of the factors discussed above. This analysis indicated a strong potential for the county continuing to exceed both state and federal oxidant standards through 1995, and the possibility of exceeding state nitrogen dioxide standards from about 1985 on. This reanalysis of the air quality implications was evaluated by EPA, ARB and the SWRCB. On the basis of this review, an additional air quality analysis was undertaken in February 1977.

The February 1977 analysis was originally oriented toward evaluating the air quality implications of a project sized according to the Department of Finance D-100 population projection. During the course of this evaluation, errors in the November 1976 analysis were discovered. The scope of the February 1977 analysis was then expanded to include a reevaluation of the project sized in accordance with the Draft Facilities Plan.

Emissions Forecasts

Base Year Emissions Inventories

Emissions forecasts are usually made by estimating future changes from current or recent levels of air pollutant emissions. Thus, an accurate "base year" emissions inventory is essential. Emissions inventories prepared by the local air pollution control district were used for the analysis presented in Appendix A-5. In August 1976 the ARB released a report providing statewide, air basin and county emissions inventory data for calendar year 1973. This data included revisions to county air pollution control district (APCD) data, especially the data for motor vehicle emissions. These revisions incorporated the new emission factor and hydrocarbon reactivity data mentioned above. Comparison of the ARB emissions inventory with the local APCD inventory for 1973 revealed several significant differences between these sources.

The reasons for these differences were determined through contacts with the ARB Emissions Inventory Unit; a revised 1973 Monterey County emissions inventory was then prepared and used in developing a revised 1974 emissions inventory. Table III, which follows the narrative section of this appendix, explains the modifications which were made to the ARB and APCD data. Briefly, discrepancies involved a failure of the ARB data to fully account for all pesticide and herbicide usage in the county, and the accidental deletion from the ARB data of NO_x emissions from agricultural product processing and agricultural burning. Differences in motor vehicle emissions estimates presented by the APCD and ARB were due primarily to different estimates of historical VMT levels; the APCD data were also based on outdated vehicle emission factor data. To maintain consistency with the emissions forecasts used in this analysis, a separate estimate of motor vehicle emissions based on VMT data from the county transportation study was prepared.

Emissions Projections

The basic steps used in estimating future pollutant emissions levels are identified in Tables III-VIII, which follow this narrative. Future emissions from most source categories are based on "growth factors" normalized to 1974 as a base year. Selection of 1974 as a base year was dictated by improved emissions controls or process changes which resulted in changes from 1973 conditions. Changes in pesticide formulations represented an especially significant factor. Growth factors were based either directly on population growth or on an index of economic activity correlated with population growth.

Emissions from the Moss Landing power plant were based on rather arbitrary projections of possible generation rates. PG&E anticipates a generation level of about 8 million megawatt-hours in 1980 (Exhibit C of Appendix A-5). Moss Landing has a 2,060 megawatt capacity rating. Few power plants operate consistently at much over 60 to 70 percent of their potential capacity (California Energy Resources Conservation and Development Commission, 1976). Recognizing current and anticipated problems in rapidly building major new power plants, it seemed reasonable to anticipate that this facility would be operating at a 60 to 70 percent capacity factor by 1990. Since 582 megawatts of capacity is scheduled for retirement at about 1992 or 1993 (California Energy Resources Conservation Development Commission, 1976), the 1995 power generation level was set at 70 percent of the remaining 1,478 megawatt capacity.

Aircraft emissions were based on emission factors developed in Exhibit F of Appendix A-5, 1974 emission levels and population projection data. No major aircraft emission controls are expected prior to 1981.

Motor vehicle emissions projections presented in Tables VII and VIII are based on VMT data from the County Transportation Study. VMT-weighted, class composite vehicle emission factors for Monterey County are presented in Table V. As discussed in the text of this EIS, an alternative to the MCTS data on VMT levels was also evaluated. These alternative VMT data are based on 1973 vehicle registration data, a Department of Motor Vehicles estimate of vehicle registration growth rate by vehicle type and county, and an estimate of annual vehicle mileage by vehicle type. The data used in this EIS are presented in Table IV.

Evaluation of VMT Estimates

The two available sources of VMT data are discussed below in terms of considerations important for air quality analysis.

MCTS Data

The Monterey County Transportation Study included the development of a computer model for forecasting future travel demands based on future population, land use, and socioeconomic forecasts. No report has yet been prepared to describe all of the assumptions, procedures, and data used in this model. The following discussion is thus based on brief descriptions presented in various MCTS documents, the MCTS traffic analysis zone map, and inferences based on a general knowledge of traffic modeling procedures used elsewhere in California.

The MCTS model has the advantages of covering all of Monterey County with a pattern of traffic analysis zones, which appears to be based largely on census tracts. A full map of the highway network used in the model has not been published in the transportation plan report or the EIR on that plan. However, it appears that most major roads are incorporated into the model network. Local neighborhood street systems are not included, however. No information is presented in the above reports to indicate whether or not correction factors are incorporated into the model to account for travel on such streets or to account for trips made solely within one traffic analysis zone.

Trip generation factors used in the model appear to be based on land use and population characteristics, and on origin-destination surveys conducted during the 1970-1972 period. The accuracy of the trip generation equations derived from these data are, of course, difficult to assess. Trip distribution along alternative routes connecting major origin and destination centers was apparently based on normal "gravity model" procedures. These procedures assign travel demands to the route having the lowest travel time. This distribution of trips did not account for congestion factors, which will develop as traffic approaches roadway capacity. Some manual readjustment of traffic volume assignments was done, however, in those cases where projected travel demand exceeded current or assumed highway capacity.

It is not clear from the transportation plan report or the EIR on the plan whether the VMT projections reflect annual average daily VMT or average weekday VMT conditions. This EIS has assumed the values are annual average daily VMT values. While VMT values for both 1974 and 1995 were produced by the model, results of any calibration or validation checks using actual 1974 traffic count data are not presented in the transportation plan report or its EIR. The VMT forecast from the model is not broken down by vehicle type, nor are the vehicle occupancy assumptions presented.

Thus, the MCTS data suffer from certain deficiencies common to most traffic models: incomplete road system coverage; probable failure to account for travel within analysis zones; lack of disaggregation of data by vehicle type; etc. Evaluation of the accuracy of the model results is also hindered by the lack of any concise technical report explaining the details of model development, validation, underlying assumptions, etc.

ARB-DMV Data

The California Air Resources Board (1976b) has compiled data by county on the numbers of vehicles in use during 1973 (by vehicle type) and the expected annual rate of increase in vehicle registrations. The vehicle registration increase rate is based on the Department of Finance D-100 population projections. Average annual mileage by vehicle type is also provided in the above report. These mileage figures are based on studies in major urban areas of the state. These data can be used to derive estimates of future vehicle numbers and future VMT for any county in the state.

The above procedure has two major strengths with regard to air quality analyses. Estimates can be made for any desired year, and VMT can be segregated by vehicle type.

One weakness of such a procedure centers on the applicability of the average annual mileage values to the Monterey Bay area. More important, however, is the fact that any VMT estimate derived by these procedures relates to total mileage traveled by vehicles registered in Monterey County, not VMT by vehicles traveling in Monterey County. VMT within Monterey County by vehicles registered elsewhere is not included, while VMT for Monterey County vehicles traveling outside the county is included. Thus, use of such VMT estimates implicitly assumes that the above two VMT sources are approximately equal. It is difficult to estimate whether tourist travel in Monterey County balances travel by county residences outside the county. Transport of agricultural produce from the Salinas Valley represents a specific VMT category where such a balance should not be automatically assumed.

Table III

MODIFIED MONTEREY COUNTY EMISSIONS INVENTORIES FOR
HYDROCARBONS AND NITROGEN OXIDES
(TONS PER DAY, ANNUAL AVERAGE)

Source Category	1973[1]			1974[2]		
	THC	RHC	NO_x	THC	RHC	NO_x
Petroleum Marketing	3.3	3.2	0	3.2	3.1	0
Solvent Users:						
Surface coatings	2.6	2.4	0	2.6	2.4	0
Degreasing	1.8	0.3	0	1.8	0.3	0
Dry cleaning	0.9	0	0	0.9	0	0
Other	7.9	5.8	0	3.1	2.3	0
Food Processing	0	0	0.8	0	0	0.8
Pesticides	10.2	10.2	0	3.3	3.3	0
Fuel Combustion:						
Power plants	0.4	0.2	24.5	0.5	0.5	17.4
Other industry	0.5	0.2	9.8	0.1	0.1	9.8
Domestic and commercial	0.3	0.1	1.5	0.1	0.1	1.5
Waste Burning:						
Agriculture and range	1.2	0.7	0.1	1.0	0.5	0.1
Other	6.5	3.4	0	3.8	2.0	0
Total Stationary Sources	35.6	26.5	36.7	20.4	14.6	29.6
Miscellaneous Area Sources	1.5	1.0	0	1.5	1.0	0
Motor Vehicles - On Road	57.9	52.6	29.7	57.3	52.0	29.5
Trains and Off-Road Vehicles	3.7	3.4	7.5	3.6	3.3	7.4
Aircraft	0.7	0.6	1.1	0.7	0.6	1.1
Total Mobile Sources	62.3	56.6	38.3	61.6	55.9	38.0
TOTAL EMISSIONS	99.4	84.1	75.0	83.5	71.5	67.6
Percent of Emissions From:						
Stationary sources	38.5	31.5	48.9	24.4	20.4	43.8
Miscellaneous area sources	1.5	1.2	0	1.8	1.4	0
Mobile sources	62.7	67.3	51.1	73.8	78.2	56.2

NOTES AND SOURCES:

THC	Total hydrocarbons
RHC	Reactive hydrocarbons (ARB reactivity Classes II and III)
NO_x	Oxides of nitrogen

[1] From California Air Resources Board, 1976c (see Appendix A-3) with the following modifications:

- All petroleum production emissions omitted to exclude the San Ardo oil fields from consideration in "base year" conditions in air quality projections.
- THC emissions associated with pesticide use from Monterey-Santa Cruz Air Pollution Control District, 1974 (Appendix A-3); RHC emissions based on ARB reactivity classification (Appendix A-6).
- NO_x emissions from food processing based on Monterey-Santa Cruz County Air Pollution Control District, 1974.
- NO_x emissions from fuel combustion by "other industry" corrected through comparison with county APCD data to exclude emissions associated with petroleum production.
- NO_x emissions from agricultural and range management burning based on Monterey-Santa Cruz County Air Pollution Control District, 1974.
- Motor vehicle emissions based on adjusted VMT level from the Monterey County Transportation Study (California Department of Transportation, 1976) and VMT-weighted, class-composite vehicle emission factors for Monterey County (see Table IV and Table V, respectively).

[2] From Monterey Bay Unified Air Pollution Control District, 1975 (see Appendix A-3) with the following modifications:

- For source categories showing no change from 1973 value in the THC emissions, RHC emissions held at 1973 level. RHC emissions for "other" solvent users category based on reactivity factor derived from 1973 data; RHC emissions for remaining source categories based on ARB reactivity classification (Appendix A-6).
- All petroleum production emissions omitted to exclude San Ardo oil fields from consideration in "base year" conditions in air quality projections.
- Miscellaneous area source emissions assumed equal to 1973 emissions reported in California Air Resources Board, 1976c.
- Motor vehicle emissions based on adjusted VMT level extrapolated from Monterey County Transportation Study and VMT-weighted, class-composite vehicle emission factors for Monterey County (see Table IV and Table V, respectively).

Table IV

COMPARISON OF POPULATION/VMT FORECASTS

Parameter	Forecast Basis	1973	1974	1980	1985	1990	1995	% Change 1973-1995
Population	MCTS[1]	251,653					392,040	55.8%
Daily VMT	MCTS[1]	4,900,000					8,736,000	78.3%
Population	D-100[2]	255,400	261,600	299,000	329,800	362,100	396,500	55.2%
Daily VMT	ARB-DMV[3]	3,460,685	3,573,781	4,251,945	4,817,123	5,382,329	5,947,534	71.9%
Population	D-100[2]	255,400	261,600	299,000	329,800	362,100	396,500	55.2%
Daily VMT	Adjusted MCTS[4]	4,972,959	5,142,676	6,166,451	7,009,560	7,893,730	8,835,384	77.7%
Population	County Composite[2]	255,400	261,600	327,879	363,136	404,040	485,339	90.0%
Daily VMT	Adjusted ARB-DMV[5]	3,460,685	3,573,781	4,671,725	5,255,774	5,933,369	7,280,127	110.4%
Population	County Composite[2]	255,400	261,600	327,879	363,136	404,040	485,339	90.0%
Daily VMT	Adjusted MCTS[6]	4,972,959	5,142,676	6,823,015	7,716,869	8,753,888	10,815,023	117.5%

NOTES:

[1] From Monterey County Transportation Study (California Department of Transportation, 1976).

[2] See Table 46 in text of EIS.

[3] Based on California Air Resources Board adjustments of Department of Motor Vehicles' vehicle registration data and projections; derived from data presented in California Air Resources Board, 1976b.

[4] 1973 and 1995 VMT extrapolated on population basis from MCTS data; 1974-1990 VMT calculated as follows (Pop = population):

19— VMT = (19— Pop - 1973 Pop) ÷ (1995 Pop - 1973 Pop) X (1995 VMT - 1973 VMT) + 1973 VMT.

[5] 1973 and 1974 values from unadjusted ARB-DMV data (see note 3). 1995 VMT extrapolated on a population basis from ARB-DMV data. 1980-1990 VMT calculated as follows:

19— VMT = (19— Pop - 1974 Pop) ÷ (1995 Pop - 1974 Pop) X (1995 VMT - 1974 VMT) + 1974 VMT.

[6] 1973 and 1974 values from D-100 based adjustment of MCTS data (see note 4). 1995 VMT extrapolated on a population basis from unadjusted MCTS data. 1980-1990 VMT calculated by procedure outlines in note 5 above.

Table V

COMPOSITE VEHICLE EMISSION FACTORS FOR MONTEREY COUNTY (GRAMS PER MILE)

Vehicle Type	Parameter	1973	1974	1980	1985	1990	1995
Light-duty autos[1]	THC	7.95	7.62	3.45	1.47	1.12	0.99
	RHC	7.22	6.92	3.18	1.37	1.03	0.91
	NO_x	4.17	3.85	2.25	1.50	1.28	1.28
	% County VMT[3]	74.07%	73.94%	73,29%	72.88%	72.56%	72.30%
Light-duty trucks[1]	THC	10.56	10.13	5.80	2.42	1.77	1.61
	RHC	9.63	9.24	5.35	2.22	1.62	1.47
	NO_x	5.03	4.71	3.96	2.78	2.57	2.46
	% County VMT[3]	11.75%	11.72%	11.62%	11.56%	11.51%	11.47%
Heavy-duty, gasoline-powered vehicles[1]	THC	34.71	32.73	20.3	15.9	12.8	12.0
	RHC	31.30	29.53	18.46	14.56	11.81	11.1
	NO_x	8.9	9.4	11.1	11.7	12.4	12.4
	% County VMT[3]	9.04%	9.14%	9.62%	9.92%	10.16%	10.35%
Heavy-duty, diesel-powered vehicles[1]	THC	5.2	5.2	5.2	5.2	5.2	5.2
	RHC	5.06	5.06	50.6	5.06	5.06	5.06
	NO_x	20.9	20.9	20.3	20.3	20.3	20.3
	% County VMT[3]	4.49%	4.54%	4.78%	4.93%	5.04%	5.14%
Motorcycles[2]	THC	8.82	8.82	7.21	6.78	2.28	2.28
	RHC	7.87	7.87	6.44	6.06	2.07	2.07
	NO_x	0.2	0.2	0.24	0.26	0.38	0.38
	% County VMT[3]	0.66%	0.66%	0.69%	0.71%	0.73%	0.74%
VMT-weighted, class-composite emission factors	THC	10.56	10.11	5.45	3.23	2.60	2.43
	RHC	9.59	9.18	5.01	2.99	2.40	2.25
	NO_x	5.42	5.21	4.15	3.58	3.51	3.54

NOTES AND SOURCES:

THC	Total hydrocarbons
RHC	Reactive hydrocarbons (ARB reactivity Classes II and III)
NO_x	Oxides of nitrogen
VMT	Vehicle miles of travel

[1] Composite vehicle emission rates from California Air Resources Board, 1976b. Exhaust THC and NO_x emission rates for light-duty autos and light-duty trucks have been corrected to reflect average "smog season" (March through October) ambient air temperature (59°F; see Appendix Table B-1). Temperature correction factors for 59°F normalized against correction factors for 75°C, based on equations presented in U. S. Environmental Protection Agency, 1976. Exhaust, evaporative, and crankcase hydrocarbon reactivity factors taken from California Air Resources Board, 1976b (see Appendix A-6).

[2] 1973 and 1974 emission rates from California Air Resources Board, 1976b. 1980-1995 exhaust THC and NO_x emission rates calculated from model year emission factors and average VMT distributions by age class as presented in U. S. Environmental Protection Agency, 1976. Hydrocarbon reactivity factors from Appendix A-6.

[3] Calculated from 1973 data on vehicles in use; projected percentage annual increase by vehicle type; and statewide average annual mileage by vehicle type as presented in California Air Resources Board, 1976b.

Table VI

COMPARISON OF EMISSION SOURCE GROWTH FACTORS

	Growth Factors Compatible With									
	D-100 Population Projection					"County Composite" Population Projection				
Source Category	1974	1980	1985	1990	1995	1974	1980	1985	1990	1995
Petroleum marketing[1]	1.00	1.14	1.26	1.38	1.52	1.00	1.25	1.39	1.54	1.86
Surface coatings[2]	1.00	1.42	1.77	2.33	2.88	1.00	1.52	1.95	2.74	3.52
Degreasing[2]	1.00	1.42	1.77	2.33	2.88	1.00	1.52	1.95	2.74	3.52
Dry cleaning[1]	1.00	1.14	1.26	1.38	1.52	1.00	1.25	1.39	1.54	1.86
Other solvent users[1]	1.00	1.14	1.26	1.38	1.52	1.00	1.25	1.39	1.54	1.86
Food processing[2]	1.00	1.26	1.48	1.78	2.07	1.00	1.34	1.63	2.09	2.54
Pesticide use[2]	1.00	1.04	1.08	1.13	1.18	1.00	1.10	1.19	1.32	1.44
Other industry fuel use[2]	1.00	1.42	1.77	2.33	2.88	1.00	1.52	1.95	2.74	3.52
Domestic and commercial fuel use[1]	1.00	1.14	1.26	1.38	1.52	1.00	1.25	1.39	1.54	1.86
Agricultural and range burning[2]	1.00	1.04	1.08	1.13	1.18	1.00	1.10	1.19	1.32	1.44
Other waste burning[1]	1.00	1.14	1.26	1.38	1.52	1.00	1.25	1.39	1.54	1.86
Miscellaneous area sources[1]	1.00	1.14	1.26	1.38	1.52	1.00	1.25	1.39	1.54	1.86
Trains and off-road vehicles[1]	1.00	1.14	1.26	1.38	1.52	1.00	1.25	1.39	1.54	1.86

NOTES AND SOURCES:

All growth factors normalized to 1974 as a base year.

[1] Growth factors directly proportional to population projections.

[2] Growth factors based on an index of economic activity, modified from D-100 based factors presented in California Air Resources Board, 1974b (see Exhibit A in Appendix A-5). 1985 and 1995 growth factors shown in Exhibit A of Appendix A-5 were normalized in 1974 as a base year assuming linear change in growth factors for the 1972-1975 period. For the "County Composite" population projection basis, the 1974-normalized, D-100 based growth factors for 1985 and 1995 were multiplied by the ratio of the "County Composite" projection to the D-100 projection. Growth factors for years other than 1985 or 1995 derived by linear interpolation.

Table VII

PROJECTED HYDROCARBON AND NITROGEN OXIDE EMISSIONS, D-100 POPULATION PROJECTION BASIS

Source Category	Projected Emissions (Tons Per Day, Annual Average)											
	1980			1985			1990			1995		
	THC	RHC	NO_x	THC	RHC	NO_x	THC	RHC	NO_x	THC	RHC	NO_x
Petroleum marketing	3.6	3.5	00	4.0	3.9	00	4.4	4.3	00	4.9	4.7	00
Solvent Users:												
Surface coatings	3.7	3.4	00	4.6	4.2	00	6.1	5.6	00	7.5	6.9	00
Degreasing	3.6	0.4	00	3.2	0.5	00	4.2	0.7	00	5.2	0.9	00
Dry cleaning	1.0	0	00	1.1	0	00	1.2	0	0	1.4	0	0
Other	3.5	2.6	0	3.9	2.9	0	4.3	3.2	0	4.7	3.5	0
Food Processing	0	0	1.0	0	0	1.2	0	0	1.4	0	0	1.7
Pesticides	3.4	3.4	0	3.6	3.6	0	3.7	3.7	0	3.9	3.9	0
Fuel Combustion:												
Power Plants	1.4	1.4	31.8	1.8	1.8	40.0	2.2	2.1	47.8	1.6	1.6	35.8
Other industry	0.1	0.1	13.9	0.2	0.2	17.3	0.2	0.2	22.8	0.3	0.3	28.2
Domestic and commercial	0.1	0.1	1.7	0.1	0.1	1.9	0.1	0.1	2.1	0.2	0.2	2.3
Waste Burning:												
Agriculture and range	1.0	0.5	0.1	1.1	0.5	0.1	1.1	0.6	0.1	1.2	0.6	0.1
Other	4.3	2.3	0	4.8	2.5	0	5.2	2.8	0	5.8	3.0	0
Total Stationary Sources	24.7	17.7	48.5	28.4	20.2	60.5	32.7	23.3	74.2	36.8	25.6	68.1
Miscellaneous Area Sources	1.7	1.1	0	1.9	1.3	0	2.1	1.4	0	2.3	1.5	0
Motor Vehicles-On-Road	37.0	34.1	28.2	25.0	23.1	27.7	22.6	20.9	30.5	23.7	21.9	34.5
Trains and Off-Road Vehicles	4.1	3.8	8.4	4.5	4.2	9.3	5.0	4.6	10.2	5.5	5.0	11.2
Aircraft	0.8	0.7	1.3	0.6	0.6	1.2	0.5	0.4	1.2	0.4	0.4	1.2
Total Mobile Sources	41.9	38.6	37.9	30.1	27.9	38.2	28.1	25.9	41.9	29.6	27.3	46.9
TOTAL EMISSIONS	68.3	57.4	86.4	60.4	49.8	98.7	62.9	50.6	116.1	68.7	54.4	115.0
Percent of Emissions From:												
Stationary Sources	36.2	30.8	56.1	47.0	40.9	61.3	52.0	46.0	63.9	53.6	47.1	59.2
Miscellaneous Area Sources	2.5	1.9	0	3.1	2.6	0	3.3	2.8	0	3.3	2.8	0
Mobile Sources	61.3	67.2	43.9	49.8	56.5	38.7	44.7	51.2	36.1	43.1	50.2	40.8

NOTES AND SOURCES:

THC	Total hydrocarbons.
RHC	Reactive hydrocarbons (ARB reactivity Classes II and III.
NO_x	Oxides of nitrogen.

Except for power plants, motor vehicles and aircraft, emissions projections are based on 1974 average daily emissions (Table III) times the appropriate growth factor listed in Table VI.

Power plant THC and NO_x emissions based on the following annual power generation assumptions (see Exhibit C, Appendix A-5):

1980	8 million megawatt-hours (44% capacity factor).
1985	10 million megawatt-hours (55% capacity factor).
1990	12 million megawatt-hours (66% capacity factor).
1995	9 million megawatt-hours (70% capacity factor following retirement of 582 megawatts of capacity in 1992 as projected in California Energy Resources Conservation and Development Commission, 1976).

Fuel oil assumed to be the exclusive fuel (Exhibit C, Appendix A-5). THC and NO_x emission factors from California Air Resources Board, 1976b (Exhibit 1). Hydrocarbon reactivity factor from Appendix A-6.

Motor vehicle emissions based on adjusted MCTS VMT projections (Table IV) and VMT-weighted, class composite vehicle emission factors for Monterey County (Table V).

Aircraft emissions based on weighted composite emission factors developed in Appendix A-5 (see Exhibit F) and D-100 population projections:

$$19\text{— emissions} = 1974 \text{ emissions} \times \frac{19\text{— Population}}{1974 \text{ Population}} \times \frac{19\text{— Emission Factor}}{1975 \text{ Emission Factor}}$$

1980 aircraft emissions factor = 1975 value; 1990 emission factor extrapolated from data in Exhibit F of Appendix A-5.

Table VIII

PROJECTED HYDROCARBON AND NITROGEN OXIDE EMISSIONS, COUNTY COMPOSITE POPULATION PROJECTION BASIS

Source Category	Projected Emissions (Tons Per Day, Annual Average)											
	1980			1985			1990			1995		
	THC	RHC	NO_x	THC	RHC	NO_x	THC	RHC	NO_x	THC	RHC	NO_x
Petroleum Marketing	4.0	3.9	0	4.4	4.3	0	4.9	4.8	0	6.0	5.8	0
Solvent Users:												
Surface coatings	4.0	3.6	0	5.1	4.7	0	7.1	6.6	0	9.2	8.4	0
Degreasing	2.7	0.5	0	3.5	0.6	0	4.9	0.8	0	6.3	1.1	0
Dry cleaning	1.1	0	0	1.3	0	0	1.4	0	0	1.7	0	0
Other	3.9	2.9	0	4.3	3.2	0	4.8	3.5	0	5.8	4.3	0
Food Processing	0	0	1.1	0	0	1.3	0	0	1.7	0	0	2.0
Pesticides	3.6	3.6	0	3.9	3.9	0	4.4	4.4	0	4.8	4.8	0
Fuel Combustion:												
Power plants	1.4	1.4	31.8	1.8	1.8	40.0	2.2	2.1	47.8	1.6	1.6	35.8
Other industry	0.2	0.2	14.9	0.2	0.2	19.1	0.3	0.3	26.9	0.4	0.4	34.5
Domestic and commercial	0.1	0.1	1.9	0.1	0.1	2.1	0.2	0.2	2.3	0.2	0.2	2.8
Waste Burning:												
Agriculture and range	1.1	0.6	0.1	1.2	0.6	0.1	1.3	0.7	0.1	1.4	0.7	0.1
Other	4.8	2.5	0	5.3	2.8	0	5.9	3.1	0	7.1	3.7	0
Total Stationary Sources	26.9	19.3	49.8	31.1	22.2	62.6	37.4	26.5	78.8	44.5	31.0	75.2
Miscellaneous Area Sources	1.9	1.3	0	2.1	1.4	0	2.3	1.5	0	2.8	1.9	0
Motor Vehicles-On-Road	41.0	37.7	31.2	27.5	25.4	30.5	25.1	23.2	33.9	29.0	26.8	42.2
Trains and Off-Road Vehicles	4.5	4.1	9.3	5.0	4.6	10.3	5.5	5.1	11.4	6.7	6.1	13.8
Aircraft	0.9	0.8	1.4	0.7	0.7	1.3	0.6	0.5	1.3	0.5	0.5	1.5
Total Mobile Sources	46.4	42.6	41.9	33.2	30.7	42.1	31.2	28.8	46.6	36.2	33.4	57.5
TOTAL EMISSIONS	75.2	63.2	91.7	66.4	54.3	104.7	70.9	56.8	125.4	83.5	66.3	132.7
Percent of Emissions From:												
Stationary sources	35.8	30.5	54.3	46.8	40.9	59.8	52.8	46.7	62.8	53.3	46.8	56.7
Miscellaneous area sources	2.5	2.1	0	3.2	2.6	0	3.2	2.6	0	3.4	2.9	0
Mobile sources	61.7	67.4	45.7	50.0	56.5	40.2	44.0	50.7	37.2	43.4	50.4	43.3

NOTES AND SOURCES:

THC	Total hydrocarbons.
RHC	Reactive hydrocarbons (ARB reactivity Classes II and III.
NO_x	Oxides of nitrogen.

Except for power plants, motor vehicles, and aircraft, emissions projections are based on 1974 average daily emissions (Table III) times the appropriate growth factor listed in Table VI.

Power plant THC and NO_x emissions based on the following annual power generation assumptions (see Exhibit C, Appendix A-5):

1980	8 million megawatt-hours (44% capacity factor).
1985	10 million megawatt-hours (55% capacity factor).
1990	12 million megawatt-hours (66% capacity factor).
1995	9 million megawatt-hours (70% capacity factor following retirement of 582 megawatts of capacity in 1992 as projected in California Ene[illegible]esources and Development Commission, 1976).

Fuel oil assumed to be the exclusive fuel (Exhibit C, Appendix A-5). THC and NO_x emission factors from California Air Resources Board, 1976b (Exhibit 1). Hydrocarbon reactivity factor from Appendix A-6.

Motor vehicle emissions based on adjusted MCTS VMT projections (Table IV) and VMT-weighted, class-composite vehicle emission factors for Monterey County (Table V).

Aircraft emissions based on weighted, composite emission factors developed in Appendix A-5 (see Exhibit F) and County Composite population projections (Table 46 in EIS text:

$$\text{19-- Emissions} = \text{1974 Emissions} \times \frac{\text{19-- Population}}{\text{1974 Population}} \times \frac{\text{19-- Emission Factor}}{\text{1974 Emission Factor}}$$

1980 emission factor = 1975 value; 1990 emission factor extrapolated from data in Exhibit F of Appendix A-5.

Exhibit 1

Emission Factors for Emissions from Fossil Fuel Electric Generating Plants in Tons Per Day/Million MWH Per Year

Pollutant	Fuel Type		
	Gas (Natural and Synthetic)	Fuel Oil	Coal
Oxides of Nitrogen (NO_x)	2.04	3.98	9.45
Particulate Matter (PM)	0.14	0.72	1.35
Sulfur Dioxide (SO_2)	0.54	14.58(S) where (S) represents sulfur content of fuel in %; e.g. 0.5% yields a factor of 7.29. Use 1% if no information available.	16.20
Total Organic Gases (TOG)	0.01	0.18	0.17
Carbon Monoxide (CO)	0.23	0.27	0.56

Source: California Air Resources Board, 1976b.

Table B-1

AVERAGE MONTHLY TEMPERATURE AND PRECIPITATION IN MONTEREY-SALINAS AREA

	STATION	PERIOD OF RECORD	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL	MAXIMUM TEMPERATURE	MINIMUM TEMPERATURE
TEMPERATURE	Salinas FAA AD	1945-1974	49.6	51.8	52.7	55.2	57.9	60.6	63.0	62.5	63.9	61.0	55.7	50.6	56.9	104	20
	Salinas 3E	1970-1974	50.5	53.2	54.2	54.9	58.0	60.9	62.0	62.8	63.5	59.6	54.6	50.0	56.5	106	24
	Monterey FAA AD	1972-1974	50.1	52.6	52.3	55.5	56.1	60.5	61.3	60.7	62.2	59.7	54.9	50.8	56.1	94	32
	Salinas 2E	1958-1968	50.3	52.2	53.1	55.5	57.9	60.8	61.9	63.3	63.7	62.0	55.9	51.1	57.1	102	23
	Monterey Nalf	1968-1971	51.4	52.3	53.0	51.6	55.8	58.9	60.1	60.2	61.3	57.1	54.7	50.6	55.5	101	28
	Monterey	1949-1974	50.6	51.6	52.9	54.1	55.7	59.2	59.2	60.3	62.2	60.6	56.6	52.0	56.4	101	23
	Carmel Valley	1959-1974	50.5	51.9	52.5	54.2	56.6	61.0	62.8	63.5	64.2	61.9	55.4	50.6	57.1	110	21
	Del Monte	1948	39.1	47.2	50.7	55.4	56.4	61.6	61.9	62.0	59.4	56.6	-	-	-	92	25
PRECIPITATION	Salinas FAA AP	1945-1974	3.62	1.76	1.91	1.34	0.25	0.09	0.03	0.04	0.06	0.53	2.69	2.82	13.67		
	Carmel Valley	1959-1974	3.98	2.97	2.26	1.43	0.26	0.11	0.03	0.04	0.18	0.54	2.64	2.87	17.31		
	Salinas 2E	1958-1969	2.97	2.36	1.61	1.33	0.19	0.12	0.02	0.07	0.64	0.35	1.65	2.20	13.66		
	Salinas 3E	1970-1974	2.84	1.82	2.21	1.36	0.18	0.16	0.09	0.00	0.05	0.95	3.58	3.66	16.15		
	Spreckels Hwy Bridge	1945-1973	7.54	2.03	1.96	1.21	0.31	0.08	0.03	0.03	0.24	0.98	1.76	2.66	13.69		
	Monterey	1949-1974	4.23	2.60	2.77	1.66	0.50	0.21	0.06	0.10	0.28	0.61	3.53	3.28	18.55		
	Fort Ord	1968-1974	3.43	3.42	1.51	.85	0.10	0.07	0.03	0.14	0.08	0.75	3.21	2.74	16.31		
	Monterey Nalf	1968-1972	4.61	2.86	1.52	1.17	0.08	0.10	0.00	0.02	0.09	0.25	1.88	2.72	15.32		
	Monterey FAA A	1972-1974	3.73	2.65	2.65	1.24	0.00	0.00	0. 4	0.00	0.02	1.99	3.62	2.03	18.86		
	Del Monte	1950-1951	4.26	2.13	1.01	.86	.25	0.00	0.00	0.00	0.00	1.70	3.93	-			

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Source: ESSA U. S. Department of Commerce data presented in Engineering Science, Inc., 1975.

Table B-2

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE
P. O. Box 8247
San Francisco, California 94128

Date: May 29, 1975

Reply to Attn of: Official in Charge

Subject: Wind Data

To: John L. Maloney, Monterey Bay Unified Air Polution Control District

We have some of the data for which you asked in your letter of May 20, 1975. The data are summarized below.

Percent of time and average velocity of wind from the various directions for the stations listed.

	Monterey 36° 35'N 121° 53'W		Paso Robles 35° 36'N 120° 39'W		Salinas 36° 40'N 121° 36'W	
	Pct.	Ave.	Pct.	Ave.	Pct.	Ave.
N	16.0	7.2	8.4	6.3	4.3	6.3
NNE	*	.5	4.4	5.0	1.2	5.7
NE	1.5	3.3	4.8	4.8	1.1	4.4
ENE	0	-	3.3	7.4	0.6	4.9
E	11.8	4.9	2.8	5.5	2.0	5.5
ESE	*	0.4	2.8	3.3	4.2	9.8
SE	6.3	4.4	3.3	2.8	16.0	11.1
SSE	0	-	3.3	5.0	3.3	8.5
S	3.6	6.9	3.1	10.5	2.3	5.6
SSW	*	1.2	6.0	8.1	0.7	4.9
SW	5.5	10.8	9.0	7.9	2.5	6.0
WSW	0.9	4.3	8.5	9.5	3.4	8.2
W	24.1	7.7	3.2	4.6	12.5	9.5
WNW	0.8	1.2	3.6	6.4	14.3	10.3
NW	22.8	8.4	8.5	7.6	18.9	9.1
NNW	1.5	5.8	9.8	9.3	5.5	8.0
CALM	4.0	-	15.4	-	7.2	-

* Less than 1/2 of one persent.

Source: Abercrombie, pers. comm.

Table B-3

WIND FREQUENCY DISTRIBUTIONS FOR HOLLISTER

Direction	Percent Frequency	Average Strength (mph)
W	32.9	8.5
SW	16.5	12.6
E	12.1	3.4
N	7.2	4.1
NW	6.3	4.9
S	5.5	5.4
WSW	5.1	10.0
SE	4.3	4.5
WNW	2.9	7.0
NE	2.0	2.2
ESE	0.6	4.6
SSW	0.4	2.2
NNW	0.2	1.3
NNE	0.2	0.6
SSE	0.2	1.4
ENE	0.1	1.3
CALM	3.3	--

Source: National Weather Service.

Table B-4

WIND CONDITIONS ON DAYS WITH HIGH OXIDANT LEVELS IN THE MONTEREY BAY AREA

Date		Direction[1]	Wind Speed[1]		Maximum 1-Hour Oxidant Level[2]		
			Knots	MPH	Gonzales	Salinas	Monterey
4-10-73		300-320° (NW)	8-15	7-13	0.125	0.177	0.109
6-19-73		290-350° (N,WW)	8-13	7-11.3	0.094	0.031	0.031
6-20-73	AM:	110-130° (E,SE)	8-12	7-10.4	0.101	0.055	0.055
	PM:	310-330° (NW)	12-14	10.4-12.2			
6-21-73		310-340° (NW)	10-18	8.7-15.6	0.078	0.039	0.047
6-25-73		290-350° (N,NW)	8-14	7-12.2	0.047	0.031	0.023
6-26-73		330-350° (N,NW)	12-16	10.4-13.9	0.078	0.047	0.047
9-27-73		130-140° (SE)	11-14	9.6-12.2	0.047	0.078	0.109
9-28-73		310-330° (NW)	8-12	7-10.4	0.078	0.070	0.101
9-29-73		300-350° (N,NW)	10-12	8.7-10.4	0.062	0.047	0.047
10-5-73		290-340° (NW)	11-14	9.6-12.2	0.055	0.055	0.055
10-6-73	AM:	120-140° (SE)	9-10	7.8-8.7	0.039	0.055	0.070
	PM:	290-010° (N,NW)	6-10	5.2-8.7			
10-13-73		310-330° (NW)	8-10	7-8.7	0.070	0.086	0.086
10-14-73		320-340° (N,NW)	9-12	7.8-10.4	0.055	0.055	0.094
10-15-73		300-310° (W,NW)	8-12	7-10.4	0.055	0.062	0.109
10-16-73		300-320° (NW)	8-10	7-8,7	0.070	0.094	0.062
10-17-73		310-330° (NW)	10-12	8.7-10.4	0.062	0.062	0.055
10-29-73		300-020° (N,NW)	8-12	7-10.4	0.047	0.031	0.039
10-30-73		110-140° (E,SE)	8-18	7-15.6	0.062	0.101	0.062
10-31-73		320-350° (N,NW)	10-12	8.7-10.4	0.062	0.094	0.086

NOTES AND SOURCES:

[1] Wind speeds and directions at Salinas airport (Campbell, pers. comm.).

[2] Values in parts per million by volume, corrected by 0.78 factor (see Appendix A-2) from values reported in California Air Resources Board, 1973b.

APPENDIX C

SOILS

Reproduced from best available copy.

Table C-1

TABLE OF SOIL CHARACTERISTICS AND QUALITIES

CS-77

SURVEY AREA MONTEREY COUNTY GENERAL SOIL MAP   Date August 1967   Prepared by TDC, LWW, JHK, ROG, CJW, JMC, DCE, CSB   Sheet 1 of 8

Map Symbol	Soil Name	Position	Profile (dry)			Natural Drainage	Subsoil Perm	Runoff	Erosion Hazard	Effective Depth (inches)	A.W.C. 1/ (inches)	Inherent Fertility	Present Land Use
			Surface Layer	Subsoil	Substratum or Parent Material								
GROUP 1 -	AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL, SOMEWHAT POORLY TO VERY POORLY DRAINED SOILS												
Ao	Alviso association	Tidal basins											
	Alviso		Gray silty clay loam, blocky, hard, neutral, 5 to 10"	Light gray silty clay loam, blocky, hard, alkaline, 10 to 40"	Greenish gray stratified sands, peat, muck, & clay sl. acid to alkaline 10-15"+	Very poorly	Slow	Very slow	None	18-24	3-4	Very low	Recreation Wildlife
CM-Pb	Clear Lake-Pacheco association	Nearly level basins and alluvial plains											
	Clear Lake		Dark gray clay, blocky, very hard, moderately alkaline 10 to 15"	Dark gray clay, massive, extremely hard, moderately alkaline 24 to 18"	Mottled grayish brown stratified clay, massive, very hard, calcareous	Somewhat poorly	Slow	Very slow	None	48-60+	8-11	High	Cropland
	Pacheco		Dark gray clay loam, blocky, very hard, neutral 15 to 35"	Grayish brown loam, massive, very hard, mod. alkaline 20 to 30"	Mottled brownish gray silty clay loam, massive, very hard, calcareous	Somewhat poorly	Moderate to mod. slow	Slow	Slight	36-60	6-10	High	Row Crops
GROUP 2 -	AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL TO STRONGLY SLOPING WELL TO EXCESSIVELY DRAINED SOILS												
cp	Cropley association	Nearly level fans and alluvial plains											
	Cropley		Dark gray clay, weak granular, moderately alkaline 8 to 12"	Grayish brown silty clay prismatic, very hard, alkaline 12 to 24"	Grayish brown clay loam massive, hard, moderately alkaline 24"+	Well	Slow	Medium	None	60+	10-12	High	Cropland
Fc A	Farallone association, 0 to 2 percent slopes	Nearly level fans and alluvial plains											
	Farallone		Dark grayish brown gravelly sandy loam, sl. hard, neutral 10 to 12"	Brown coarse sandy loam, blocky, slightly hard, mildly alkaline 20 to 28"	Brown loamy coarse sand, massive, soft, alkaline 20 to 30"+	Well	Moderate to mod. rapid	Slow	Slight	60+	5-7.5	Moderate	Cropland
Mt-Rm AC	Metz-Riverwash association, 0 to 9 percent slopes	Nearly level to moderately sloping flood plains											
	Metz		Light gray silts and sand loose, calcareous 8 to 20"	Light gray stratified sands, loose, calcareous 10 to 30"	Light gray, stratified sands and gravels, calcareous 10 to 40"+	Somewhat excessive	Rapid	Slow	None	60+	4-5	Low	Pasture Cropland Range
	Riverwash		Stratified sand, gravels and stones along active stream channel; barren			Excessive	Very rapid	Very rapid	Very high	Variable	1-2	Very low	Usually barren
MM-MC	Mocho-Metz association	Nearly level alluvial plains											
	Mocho		Grayish brown loam, weak blocky, slightly hard, calcareous 14 to 20"	Light grayish brown, sandy loam, massive, hard calcareous 20 to 26"	Pale brown loamy fine sand, massive, loose calcareous 14 to 26"+	Well	Moderately rapid	Slow	None	60+	7.5-8	Moderately high	Cropland
	Metz		Light brownish gray fine sandy loam, slightly hard calcareous 10 to 25"	Light brownish gray fine sand, massive, loose, calcareous 10 to 30"	Light brownish gray, stratified sands, loose calcareous 10 to 40"+	Well	Rapid	Slow	None	60+	5-6	Moderate	Cropland
Sd-MM	Salinas-Mocho association	Nearly level alluvial plains, fans and terraces											
	Salinas		Very dark gray clay loam, blocky, very hard, mod. alkaline 10 to 15"	Dark gray or grayish brown silt loam, blocky, mod. alkaline 20 to 30"	Grayish brown sandy loam, massive, soft, calcareous 35"+	Well	Moderate to mod. slow	Medium	None	60+	8-11	High	Cropland
	Mocho		Grayish brown silty clay loam, blocky, hard, calcareous 18 to 24"	Light grayish brown silty clay loam, massive, hard, calcareous 16-22"	Light brownish gray, silty clay loam, massive, hard, calcareous 20-30"	Well	Moderate to mod. slow	Medium	Slight	60+	8-10	High	Cropland Range
GROUP 3 -	AREAS DOMINATED BY DEEP AND VERY DEEP, COARSE TO MODERATELY COARSE TEXTURED SOILS ON STABILIZED SAND DUNES AND SOFT SANDSTONES												
Ab EF-2	Arnold association, 15 to 30 percent slopes, eroded	Steep to very steep hills											
	Arnold		Grayish brown loamy sand weak, blocky, sl. hard, medium acid 10 to 15"	Brown loamy sand, massive slightly hard, medium acid 10 to 20"	Pale brown to light gray sand, massive, soft, neutral - medium acid	Excessive	Rapid	Medium	Moderate	30-60	2-4	Low	Range Pasture Wildlife

SCS-77

SURVEY AREA MONTEREY COUNTY GENERAL SOIL MAP

TABLE OF SOIL CHARACTERISTICS AND QUALITIES

Date August 1967 Prepared by TDC, LWW, JHK, RDC, CJW, JMC, DCE, CSB Sheet 2 of 8

Map Symbol	Soil Name	Position	Profile (dry)			Natural Drainage	Subsoil Perm.	Runoff	Erosion Hazard	Effective Depth (inches)	AWC [1] (inches)	Inherent Fertility	Present Land Use
			Surface Layer	Subsoil	Substratum or Parent Material								
Mz-Bl / BD	Marina-Baywood association, 2 to 15 percent slopes	Gently sloping to rolling stabilized dune land											
	Marina		Grayish brown loamy sand loose, slightly hard, medium acid 15 to 40"	Yellowish brown loamy sand, massive, slightly hard, medium acid	Yellowish brown loamy sand, massive, loose, slightly acid	Somewhat excessive	Rapid	Medium	Moderate	60+	4-6	Very low	Pasture
	Baywood		Dark grayish brown sand, weak granular, slightly hard, sl. acid 15 to 30"	Pale brown sand, massive slightly hard, medium acid 5 to 10"	Very pale brown sand, loose, slightly acid	Excessive	Very rapid	Slow	High	60+	2-3	Very low	Range
GROUP 5 -	AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, WELL DRAINED, NEARLY LEVEL TO MODERATELY STEEP SOILS WITH MODERATE TO SLOWLY PERMEABLE SUBSOILS												
CG / A	Chualar association, 0 to 2 percent slopes	Nearly level alluvial fans and low terraces											
	Chualar		Grayish brown sandy loam, granular or blocky, sl. hard, neutral 12 to 30"	Brown clay loam, blocky, very hard, alkaline 15 to 30"	Brown stratified sands and loams, loose, alkaline 15 to 25"+	Well	Moderately slow	Medium	Slight	60+	8-10	Moderately high	Cropland
CG-Fc / C	Chualar-Farallone association, 2 to 9 percent slopes	Moderately sloping terraces											
	Chualar		Grayish brown loam, granular or blocky, hard, neutral 12 to 24"	Brown clay loam, blocky, very hard, alkaline 15 to 20"	Brown stratified sands and loams, loose, alkaline 15 to 25"+	Well	Moderately slow	Medium	Slight	60+	8-10	Mod. to moderately high	Cropland Range
	Farallone		Grayish brown gravelly sandy loam, blocky, sl. hard, neutral 6 to 10"	Dark brown sandy loam, massive, slightly hard, neutral 24 to 36"	Granite, cobbles and gravel, neutral	Well	Moderate to mod. rapid	Slow	Slight	36-48	4.5-7	Moderate	Cropland
Eg / BC	Elkhorn association, 2 to 9 percent slopes	Gently to moderately sloping coastal marine terraces											
	Elkhorn		Brown sandy loam, blocky, hard, neutral 10 to 20"	Brown sandy clay loam, massive, hard, medium acid 20 to 30"	Strong brown fine sandy loam, massive, very hard slightly acid	Well	Moderately slow	Slow	Slight to moderate	40-60	6.5-7.5	Moderate	Row Crops
GROUP 6 -	AREAS DOMINATED BY SHALLOW TO DEEP, WELL TO SOMEWHAT POORLY DRAINED, GENTLY SLOPING TO STEEP SOILS WITH MODERATELY SLOWLY TO VERY SLOWLY PERMEABLE SUBSOILS												
Ax-Ga / BC	Antioch-Gloria association, 2 to 9 percent slopes	Gently to moderately sloping terraces											
	Antioch		Grayish brown loam, blocky, sl. hard, strongly acid 10 to 24"	Yellowish brown clay, columnar, very hard, alkaline 20 to 30"	Very pale brown sandy clay loam, blocky, hard, mod. alkaline 30-40"+	Moderately well	Slow to very slow	Medium	Slight	10-24	3-6	Low	Pasture Hay Cropland
	Gloria		Brown loam, massive, hard, medium & slightly acid 12 to 24"	Reddish brown clay, prismatic, extremely hard alkaline 13 to 18"	Reddish brown indurated hardpan 20 to 36"+	Well to moderately well	Very slow	Medium	Moderate	20-30	4-5	Low	Cropland Range
Ax-Gq / DE-2	Antioch-Gloria association, 9 to 30 percent slopes, eroded	Strongly sloping to moderately steep high terraces											
	Antioch		Grayish brown loam, blocky, slightly hard, strongly acid 10 to 24"	Yellowish brown clay, columnar, very hard, alkaline 20 to 30"	Very pale brown sandy clay loam, blocky, very hard, mod. alkaline 30-40"+	Moderately well	Slow	Medium	High	10-24	3-6	Low	Range Pasture
	Gloria		Brown loam, massive, hard medium and slightly acid 8 to 20"	Reddish brown clay, prismatic, extremely hard, alkaline 10 to 15"	Reddish brown indurated hardpan 20 to 36"+	Well	Very slow	Medium to rapid	High	8-20	2-4	Low to very low	Range Pasture
Gq-Pv / EF-2	Gloria-Placentia association, 15 to 50 percent slopes, eroded	Moderately steep to steep dissected high terraces											
	Gloria		Brown loam, massive, hard medium and slightly acid 8 to 20"	Reddish brown clay, prismatic, extremely hard alkaline 10 to 15"	Reddish brown indurated hardpan 20 to 36"+	Well	Very slow	Rapid	Very high	8-20	1-3	Very low to low	Range
	Placentia		Brown sandy loam, massive, hard, medium acid 6 to 24"	Dark reddish brown clay prismatic, very hard, alkaline 12 to 36"	Brown gravelly sandy loam, massive, hard, alkaline 10 to 24"+	Well	Slow	Medium	Slight	18-30	2-4	Low	Cropland Range
Nc / BC	Narlon association, 2 to 9 percent slopes	Gently to moderately sloping terraces											
	Narlon		Gray loamy fine sand, fine granular, soft, medium acid 12 to 20"	Mottled gray & yellowish brown clay, prismatic very hard, strongly acid	Light gray or white sandy clay, massive, very hard, very strongly acid	Somewhat poorly	Very slow	Slow	Slight	12-20	3-5	Very low	Woodland

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TABLE OF SOIL CHARACTERISTICS AND QUALITIES

SURVEY AREA MONTEREY COUNTY GENERAL SOIL MAP

Date August 1967 Prepared by TDC, LWW, JHK, RDG, CJW, JMC, DCE, CSB Sheet 3 of 8

Map Symbol	Soil Name	Position	Profile (dry)			Natural Drainage	Subsoil Perm.	Runoff	Erosion Hazard	Effective Depth (inches)	AWC 1/ (inches)	Inherent Fertility	Present Land Use
			Surface Layer	Subsoil	Substratum or Parent Material								
GROUP 7 -	AREAS DOMINATED BY MOSTLY CLAYEY SOILS ON GENTLY ROLLING TO MODERATELY STEEP HILLS												
DI/CD	Diablo association, 5 to 15 percent slopes	Moderately to strongly sloping hills											
	Diablo		Very dark gray clay, blocky, very hard, neutral 18 to 24"	Dark gray clay, blocky, very hard, neutral 20 to 36"	Soft shale and sandstone, shattered, calcareous	Well	Slow	Slow	Slight	38-60	6-9	High	Cropland Range
GROUP 8 -	AREAS DOMINATED BY SHALLOW TO DEEP, MODERATELY COARSE TO FINE TEXTURED SOILS FORMED ON USUALLY ACID SHALES AND SANDSTONES												
SL-G/EF	Santa Lucia-Gazos association, 15 to 50 percent slopes	Moderately steep and steep hills and mountains											
	Santa Lucia		Gray shaly clay loam, granular, weakly coherent strongly acid 12 to 15"	Grayish brown very shaly clay, granular, strongly acid 14 to 15"	Pale brown to white siliceous shales	Well	Moderate	Medium	Moderate	24-36	4-6	Moderate	Range Dry Cropland
	Gazos		Grayish brown shaly loam granular, soft, neutral 15 to 25"	Grayish brown shaly loam, blocky, slightly hard, neutral 5 to 15"	Light gray fractured shale, neutral	Well	Moderate	Medium	Moderate	20-40	5-7	Moderate	Range Dry Cropland
GROUP 10 -	AREAS DOMINATED BY MODERATELY COARSE TO MODERATELY FINE TEXTURED, VERY SHALLOW TO DEEP UPLAND SOILS FORMED ON GRANITIC BEDROCK												
CB-SH/[illegible]	Cieneba-Sheridan association, 50 to 75 percent slopes, eroded	Steep to extremely mountains											
	Cieneba		Brown gravelly sandy loam, granular, slightly hard, sl. acid 5 to 20"	Strongly weathered granite	Strongly weathered granite	Excessive	Moderately rapid	Very rapid	Very high	5-20	1-3	Low	Wildlife Watershed Recreation
	Sheridan		Dark grayish brown sandy loam, granular, soft, slightly acid 8 to 14"	Dark grayish brown gravelly sandy loam, granular, medium acid	Massive, weathered coarse crystalline granite	Well	Moderately rapid	Very rapid	Very high	20-36	2-4	Moderate	Wildlife Watershed Recreation
				10 to 22"									
Mc/T	McCoy association, 30 to 50 percent slopes	Steep hills											
	McCoy		Dark brown clay loam, blocky, hard, neutral 16 to 20"	Dark brown heavy clay loam, blocky, hard, alkaline 16 to 36"	Strongly weathered granite	Well	Moderately slow	Medium to rapid	Moderate	36-48	5-8	Moderately high	Range
SH/FG	Sheridan association, 30 to 75 percent slopes	Steep and very steep mountains		12 to 14"									
	Sheridan		Dark grayish brown gravelly loam, granular, sl. hard, sl. acid 12 to 24"	Dark grayish brown gravelly sandy loam, granular medium acid 12 to 24"	Massive, weathered coarse crystalline granite	Well	Moderate or mod. rapid	Medium	Moderate	30-48	5-6	Moderately high	Range
VE/FG-2	Vista association, 30 to 75 percent slopes, eroded	Steep and very steep mountains											
	Vista		Brown sandy loam, granular, slightly hard, medium acid 5 to 10"	Light yellowish brown sandy loam, massive medium acid 10 to 14"	Light yellowish brown weathered granite	Somewhat excessive	Moderately rapid	Rapid	High	20-24	3-4	Moderate or low	Range

1/ Total available water holding capacity within effective soil depth

Source: U. S. Department of Agriculture, Soil Conservation Service, 1968.

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Table C-2

INDEX of SOIL MAPPING UNITS and INTERPRETIVE GROUPINGS

SURVEY AREA MONTEREY COUNTY GENERAL SOIL MAP

Name TDC, LWW, JHK, RDG CJW, JMC, DCE, CSB

Date August 1967

Page 1 of 6

MAP SYMBOL	SOIL NAME	Percent 1/ of Association	Capability Unit		INTERPRETIVE GROUPING								
			Irrigated	Dry	Vegetative Group	Hydrologic Group	Range Site	Shrink-Swell Behavior	Septic Tank Filter Fields	SEWAGE LAGOON Lagoon Basin Floors (Impoundment)	SEWAGE LAGOON Embankment Material	Corrosivity Rating for Un-treated Steel Pipe	Allowable Soil Pressure
GROUP 1 - AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL, SOMEWHAT POORLY TO VERY POORLY DRAINED SOILS													
Ao	Alviso association Alviso	65 (35)		VIIIw6	J	D	3/	High shrink 2/ low swell	Severe	Slight	Moderate	High	Severe
CM-Pb	Clear Lake-Pacheco association Clear Lake Pacheco	50 35 (15)	IIw5 2/ IIw2		E E	D 2/ C	3/ 3/	High 2/ Moderate	Severe 2/ Moderate	Slight 2/ Moderate	Moderate Moderate	High High	Moderate Moderate
GROUP 2 - AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL TO STRONGLY SLOPING WELL TO EXCESSIVELY DRAINED SOILS													
Cp	Cropley association Cropley	75 (25)	IIs5		C	D	3/	High	Severe	Slight	Moderate	High	Moderate
Fc A	Farallone association, 0 to 2 percent slopes Farallone	80 (20)	IIs4		A	A	3/	Low	Slight	Severe	Moderate	Low	Moderate
MC-RW AC	Metz-Riverwash association, 0 to 9 percent slopes Metz Riverwash	50 30 (20)	IVe4 2/	VIIIw4	B 2/ J	A A	Sandy Sandy	Low Low	Moderate 2/ Severe	Severe Severe	Severe Severe	Low Low	Severe Severe
MM-MC	Mocho-Metz association Mocho Metz	50 30 (20)	I 2/ IIs4		A A	B B	3/ 3/	Moderate 2/ Low	Slight Slight	Severe Severe	Moderate 2/ Severe	Low Low	Moderate 2/ Severe
Sd-MM	Salinas-Mocho association Salinas Mocho	40 30 (30)	I I		A A	C C	3/ 3/	Moderate Moderate	Moderate Moderate	Slight Slight	Moderate Moderate	Moderate Moderate	Moderate Moderate
GROUP 4 - AREAS DOMINATED BY DEEP AND VERY DEEP, COARSE TO MODERATELY COARSE TEXTURED SOILS ON STABILIZED SAND DUNES AND SOFT SANDSTONES													
AE EF-2	Arnold association, 15 to 50 percent slopes, eroded Arnold	70 (30)		VIIs4	J	B	Sandy	Low	Severe	Severe	Severe	Low	Moderate
Mg-BI LD	Marina-Baywood association, 2 to 15 percent slopes Marina Baywood	50 40 (10)	IVe4 IVe4		B B	A A	Sandy Sandy	Low Low	Severe Severe	Severe Severe	Severe Severe	Low Low	Moderate Moderate
GROUP 5 - AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, WELL DRAINED, NEARLY LEVEL TO MODERATELY STEEP SOILS WITH MODERATE TO SLOWLY PERMEABLE SUBSOILS													
CG A	Chualar association, 0 to 2 percent slopes Chualar	65 (35)	I		A	C	3/	Moderate	Moderate	Slight	Slight	Moderate	Moderate
CG-Fc C	Chualar-Farallone association, 5 to 9 percent slopes Chualar Farallone	50 25 (25)	IIIe3 2/ IIIe4		A A	C 2/ A	Loamy Loamy	Moderate 2/ Low	Moderate Moderate	Moderate Severe	Slight 2/ Moderate	Moderate 2/ Low	Moderate Moderate
Eg BC	Elkhorn association, 2 to 9 percent slopes Elkhorn	75 (25)	IIIe1		A	C	Loamy	Moderate	Moderate	Moderate	Slight	Moderate	Moderate

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INDEX of SOIL MAPPING UNITS and INTERPRETIVE GROUPINGS

SURVEY AREA MONTEREY COUNTY GENERAL SOIL MAP

Name TDC, LWW, JHK, ROG, CJW, JMC, DCE, CSB Date August 1967
Page 3 of 6

MAP SYMBOL	SOIL NAME	Percent 1/ of Association	Capability Unit: Irrigated	Capability Unit: Dry	Vegetative Group	Hydrologic Group	Range Site	Shrink-Swell Behavior	Septic Tank Filter Fields	SEWAGE LAGOON: Lagoon Basin Floors (Impoundment)	SEWAGE LAGOON: Embankment Material	Corrosivity Rating for Untreated Steel Pipe	Allowable Soil Pressure
GROUP 6 - AREAS DOMINATED BY SHALLOW TO DEEP, WELL TO SOMEWHAT POORLY DRAINED, GENTLY SLOPING TO STEEP SOILS WITH MODERATELY SLOWLY TO VERY SLOWLY PERMEABLE SUBSOILS													
Ax-Gq BC	Antioch-Gloria association, 2 to 9 percent slopes												
	Antioch	50	IIIe3		D	D	Claypan	High	Severe	Moderate	Slight	High	Moderate 2/
	Gloria	40	IIIe3		D	D	Claypan	High	Severe	Moderate	Slight	High	Slight
		(10)											
Ax-Gq DE-2	Antioch-Gloria association, 9 to 30 percent slopes, eroded												
	Antioch	50		VIe3	D	D	Claypan	High	Severe	Severe	Slight	High	Moderate 2/
	Gloria	40		VIe3	D	D	Claypan	High	Severe	Severe	Slight	High	Slight
		(10)											
Gq-Py EF-2	Gloria-Placentia association, 15 to 50 percent slopes, eroded												
	Gloria	35		VIe3	J 2/	D	Shallow claypan	High	Severe	Severe	Slight	High	Slight
	Placentia	25		VIe3	D	D	Shallow claypan	High	Severe	Severe	Slight	High	Slight
		(40)											
Nc [illegible]	Narlon association, 2 to 9 percent slopes												
	Narlon	70	IIIe3		L	D	Claypan	High	Severe	Moderate	Slight	High	Moderate
		(30)											
GROUP 7 - AREAS DOMINATED BY MOSTLY CLAYEY SOILS ON GENTLY ROLLING TO MODERATELY STEEP HILLS													
Dl CD	Diablo association, 5 to 15 percent slopes												
	Diablo	70	IIIe5		C	D	Clayey	High	Severe	Severe	Moderate	High	Moderate
		(30)											
GROUP 8 - AREAS DOMINATED BY SHALLOW TO DEEP, MODERATELY COARSE TO FINE TEXTURED SOILS FORMED ON USUALLY ACID SHALES AND SANDSTONES													
Sk-Gq EF	Santa Lucia-Gazos association, 15 to 50 percent slopes												
	Santa Lucia	60		VIe1 2/	G	C	Loamy	Low 2/	Severe	Severe	Moderate	High 2/	Moderate
	Gazos	25		VIe5	G	C	Loamy	Moderate	Severe	Severe	Moderate	Moderate	Moderate
		(15)											
GROUP 10 - AREAS DOMINATED BY MODERATELY COARSE TO MODERATELY FINE TEXTURED, VERY SHALLOW TO DEEP UPLAND SOILS FORMED ON GRANITIC BEDROCK													
Cr-Sh G-2	Cieneba-Sheridan association, 50 to 75 percent slopes, eroded												
	Cieneba	45		VIIIs1	J	B	3/	Low	Severe	Severe	Moderate	Low	Moderate
	Sheridan	45		VIIIe1	J	B	3/	Low	Severe	Severe	Moderate	Low	Moderate
		(10)											
Mt F	McCoy association, 30 to 50 percent slopes												
	McCoy	55		VIe5	A	C	Loamy	High	Severe	Severe	Slight	Moderate	Moderate
		(45)											
Sh FG	Sheridan association, 30 to 75 percent slopes												
	Sheridan	50		VIIe4	J	B	Loamy	Low	Severe	Severe	Moderate	Low	Moderate
		(50)											
Vt FG-2	Vista association, 30 to 75 percent slopes, eroded												
	Vista	60		VIIe4	J	B	Loamy	Low	Severe	Severe	Moderate	Low	Moderate
		(40)											

1/ Percent in (-) gives extent of unnamed soils in the associations. (See descriptions)
2/ Indicates rating to be used when coloring single purpose interpretive maps.
3/ Not used for range.

Source: U. S. Department of Agriculture, Soil Conservation Service, 1968.

APPENDIX D

SEISMIC AND GEOTECHNICAL

Table D-1[1]

MONTEREY COUNTY FAULTS

Fault	C.D.M.G. Report 13		U.S. Geological Survey		Burkland Report	
	Active[2]	Potentially Active	Active	Potentially Active	Active[3]	Potentially Active
San Andreas	X		X		X	
Vergeles	inactive			X		X
Gabilan Creek	not shown		named-not shown			X
Los Lobos		X		X		X
Reliz - Riconada		X		X		X
Harper Canyon	not shown		shown-not named			X
Berwick Canyon		X				X
Chupines and Corral de Tierra		X X		X X		X X
Jolon		X		X		X
Navy	not shown			X		X
Ord Terrace	not shown			X		X
Cypress Pt.-Seaside	not shown			X		X
Monterey Bay (zone)		X	X	X	X	X
Tularcitos	inactive			X		X
Lower Carmel Valley		X		X		X
Palo Colorado and San Gregoria	X		X		X	
Sur-Nacimiento	inactive		inactive			X

---

[1] Source: Burkland and Associates, 1975.

[2] Burkland Report Definitions:
Active - Those faults which have moved or have shown activity within the last 11,000 years.
Potentially Active - Those faults which have moved or have shown activity within the last 3,000,000 years.
Inactive - Those faults that have not moved or shown activity within the last 3,000,000 years.

[3] CDMG Report Definitions:
Active - Demonstrable activity during the last 200 years.
Potentially Active - Demonstrable activity between 200 and 2,000,000 years.
Inactive - Demonstrable activity more than 2,000,000 years ago.

Table D-2*

EVALUATION OF HAZARDS

	ENGINEERING					SEISMIC					
	EXPANSIVE SOILS	EROSION	EXCAVATION	GROUND WATER	SLOPE STABILITY	LURCH CRACKING	LATERAL SPREADING	VIBRATION DAMAGE	SUBSIDENCE & UPLIFT	GROUND RUPTURE	LIQUEFACTION
I	△ TO □+	△+	□ TO ○+	△+	NA	NA	NA	△+	NA	NA	NA
II	△ TO □+	△ TO ○+	□+	□+	△ TO □+	□ TO ○+	□+	△ TO ○+	□+	NA	□ TO ○+
III	△ TO □+	△ TO □+	△+	△+	□	□+	△+	□+	△ TO □+	NA	□ TO ○+
IV	□ TO ○+	□ TO ○+	△ TO □+	△ TO ○+	○ TO □+	□+ TO ○+	□+ TO ○+	□+ TO ○+	○+	NA	□ TO ○+
V	△+	△ TO ○+	□+	□+	△ TO ○+	△ TO ○+	△ TO □+	○+	□ TO ○+	○+	□ TO ○+
VI	○+	○	□+	○+	○	○+	○+	○	□ TO ○+	○+	□ TO ○+

△ MINOR □ MODERATE ○ MAJOR

NA GENERALLY NOT APPLICABLE

+ LOCALLY

The triangles indicate that the potential geotechnical hazard is of concern in less than about 10% of the zone so designated. The squares indicate that the potential hazard is of concern in less than about 40% of that zone, whereas the circles indicate that the potential hazard is of concern in more than about 40% of that zone. A cross is used as a modifier to indicate that a particular geotechnical hazard is a localized one as well as being a potential problem throughout the zone. The symbols, then, are intended to indicate the potential for distribution within a zone rather than the severity of the hazard within that zone.

* Source: Burkland and Associates, 1975.

APPENDIX E

SURFACE WATER QUALITY AND QUANTITY

Table E-1

SALINAS RIVER WATER QUALITY

Parameter	Highway 68*		Blanco Road*		Highway 1*	
	Recorded Units	Sample Period and Source**	Recorded Units	Sample Period and Source**	Recorded Units	Sample Period and Source**
Turbidity ppm formazin	1-34	6/75-9/75[4]	8-17	6/75-9/75[4]		
Specific conductance mmhos/cm^3	890	n.d.[3]			2,400	n.d.[3]
TDS ppm	360-1,480	1941-1971[2]			1,400	n.d.[3]
Hardness ppm	304	n.d.[3]			460	n.d.[3]
DO mg/l	8.6-11.4	6/75-9/75[4]	5.6-6.2	6/75-9/75[4]	3.0-17.6	4/72-10/72[6]
5-Day BOD mg/l	4.6-8.4	6/75-9/75[4]	3.1-7.9	6/75-9/75[4]		
Orthophosphate - P mg/l	0.00-0.45	6/75-9/75[4]	0.01-1.82	6/75-9/75	5.4	12/14/71[6]
Total P mg/l	0.39-13	11/71-6/72[1]			6.3	11/4/71[6]
Nitrate as N mg/l	13	n.d.[3]			4.3-4.5	4/72-10/72[6]
Ammonia (NH_4) AS/N mg/l	0.32-9.6	11/71-6/72[1]			4.1	11/4/71[6]
Boron mg/l	0.3	n.d.[3]			0.70	n.d.[3]
Chloride mg/l	80	n.d.[3]			372	n.d.[3]
Sulfate mg/l	64	n.d.[3]			304	n.d.[3]
Sodium mg/l	74	n.d.[3]			312	n.d.[3]
Total Coliforms MPN/100 ml	20-700,000	1941-1971[2]	2,400	5/71[5]	1,950	5/71[5]

* Sampling locations are shown on Figure

** Sources:
[1] U. S. Geological Survey, 1972.
[2] U. S. Bureau of Reclamation, 1974.
[3] Yoder-Trotter-Orlob & Associates, 1973.
[4] Northern Salinas Valley Mosquito Abatement District, 1975.
[5] California State Department of Public Health, 1972.
[6] California Department of Water Resources, pers. comm.

Table E-2

PESTICIDES IN LOWER SALINAS RIVER IN PARTS PER TRILLION (ppt)

Location	Date of Sample	DDT	Dieldrin	Diazinon	Parathion	Dacthal
Salinas River at Highway 1	11/4/71	80	32			160
	5/23/72		1,600		25	100
	8/22/72		230		40	520
Salinas River at Blanco Drain	11/4/71		60			390
Salinas River at Blanco Road	11/4/71	440				360
	8/22/72		700		110	3,600
Salinas River at Davis Road	11/4/71	150				340
	8/22/72				1,000	7,000
Salinas River at Gonzales	4/25/72		10	45	55	
	8/23/72		10			10

Source: California Department of Water Resources, 1973.

Table E-3

ELKHORN SLOUGH WATER QUALITY - 1975

	Highway 1*		Kirby Park*			Carneros Slough Inlet*				
	Aug	Sep	Jun	Jul	Aug	Sep	Jun	Jul	Aug	Sep
Temperature, °C	16	15	18	21	18	20	21	22	19	18.5
Turbidity, ppm formazin	1	2	31	27	15	8	34	13	35	20
pH	7.8	8.0	6.65	7.5	7.5	7.7	6.65	7.5	7.4	7.6
Dissolved Oxygen, ppm O_2	6.8	7.9	7.0	5.8	4.6	5.4	9.2	4.5	6.6	4.6
5-Day BOD, ppm O_2	6.2	3.9	--	4.6	6.1	2.9	--	3.7	4.5	2.9
Orthophosphate P, ppm P	0.09	0.23	0	0.13	0.02	0.37	0	0.20	0.05	0.11
Ammonia-Nitrogen, ppm N	0.05	0.16	0.76	0.06	0.5	0.08	0.15	0.25	0.17	0.03
Nitrate-Nitrogen, ppm N	0.22	0.08	--	0.38	0.20	0.07	--	0.30	0.13	0.09

* See Figure for location of sampling stations.

Source: Northern Salinas Valley Mosquito Abatement District, 1975.

Table E-4

WATER QUALITY DATA -- MAIN RECLAMATION DITCH

Location	TDS mg/l	Cl mg/l	Phosphate mg/l	Nitrate mg/l	Fecal Coliform MPN/100 ml	Total Pesticides ppt*	Malathion ppt	Diazinon ppt	Heptachlor ppt
Airport Boulevard[1] (east of Salinas)	360-377	91-100	1-4	15-59	230-62,000	4,790	1,480	650	60
Borondo Road[1] (1/2 mile west of Salinas)	497-966	131-190	2.8-5.8	33-48	—	7,930	140	480	50
San Jon Road[2] (3.4 miles southwest of Salinas)	362-1,042	62-262	—	—	—	—	—	—	—
Espinoza Road[1] (12 miles west of Salinas)	575-834	138-165	3.3-3.8	12-45	—	>3,690	110	400	40

---

[1] Recorded in May 1971 by California State Department of Public Health, 1971.

[2] Recorded on various dates, 1969-71, by Monterey County Flood Control and Water Conservation District, n.d.

Table E-5

WATER QUALITY -- OLD SALINAS RIVER ABOVE TEMBLADERO SLOUGH

Date	DO mg/l	Temp. °F	pH	EC mmhos/cm	NO_3 mg/l	B mg/l	BOD mg/l	COD mg/l	TOTP mg/l	Cad. mg/l	Pb mg/l	Merc. mg/l
4/25/72	15.3	72	8.5	2,090	1.1	0.50	24	60	1.4	0.00	0.00	0.0001
5/23/72	7.6	61	8.9	3,390	0.13	1.00	—	—	—	0.00	0.01	0.0001
8/23/72	6.5	70	8.7	2,990	0.9	0.80	—	—	—	0.00	0.00	0.000
10/25/72	13.7	—	8.4	2,500	2.8	0.80	—	—	—	0.00	0.00	0.000

Source: California Department of Water Resources, 1973 and 1974; sampling location shown in Figure .

LEGEND TO ABBREVIATIONS:

NO_3	Nitrate
B	Boron
COB	Chemical oxygen demand
TOTP	Total phosphorous
Cad.	Cadmium
Pb	Lead
Merc.	Mercury

For other definitions, see Water Resources glossary in text.

Table E-6

Sanitary Engineering Field Study of Monterey Bay
February 2-13, 1970
Certain Bacteriological Data Compared: August 1969 study vs February 1970 study

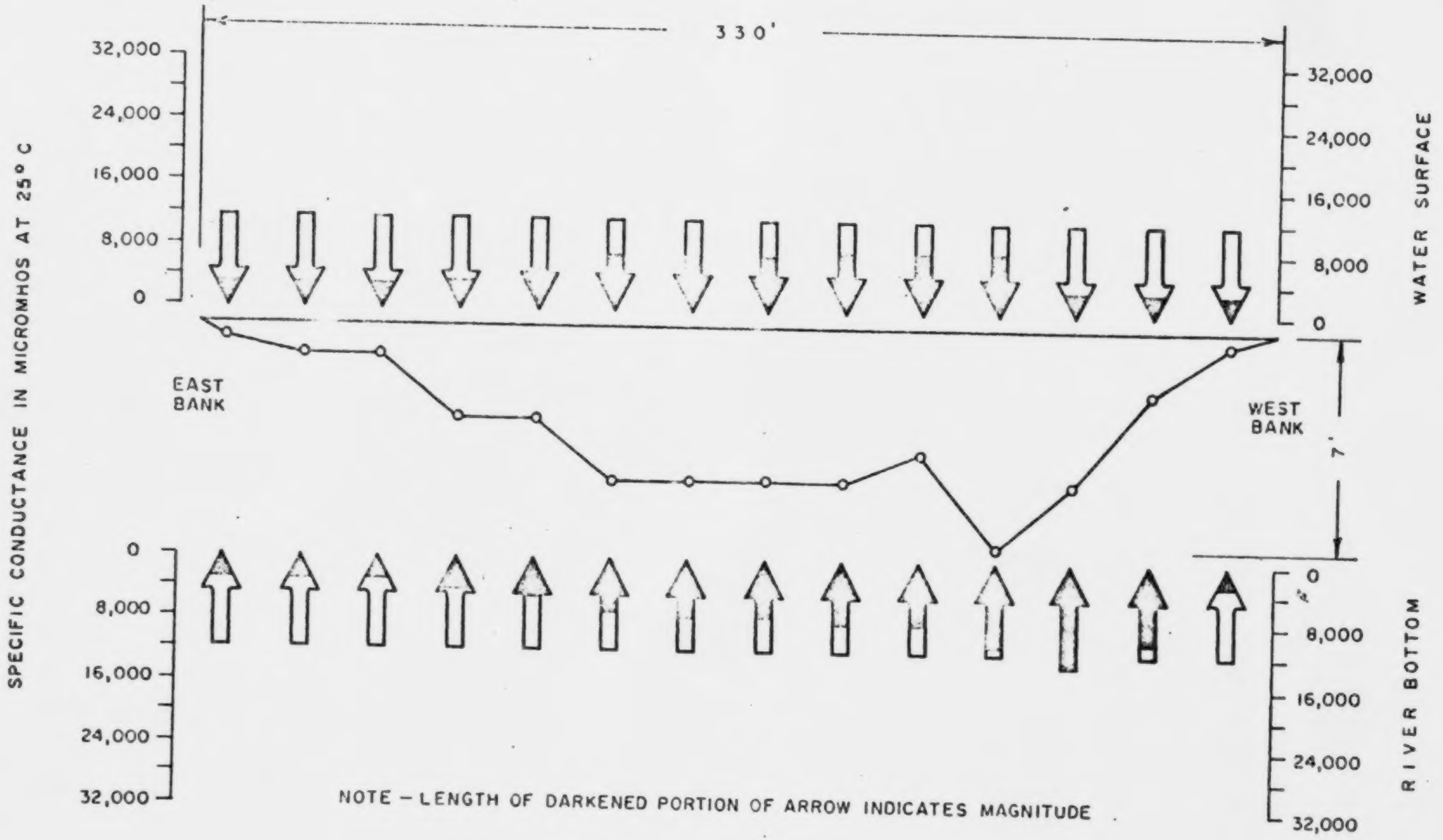
Sampling stations in the vicinity of:		August 1969 study coliform MPN per 100 ml.			February 1970 study coliform MPN per 100 ml.		
		Max.	**Min.**	**Median**	**Max.**	**Min.**	**Median**
Santa Cruz:	Beach	≥ 24,000*	40	90	≥ 24,000	<30	430
	offshore	150	<30	40	11,000	<30	90
East Cliff:	Beach	2,400	<30	40	≥ 24,000	<30	90
	offshore	11,000	<30	40	4,600	<30	40
Aptos :	Beach	430	<30	<30	4,600	<30	150
	offshore	90	<30	<30	430	<30	90
Watsonville:	Beach	230	<30	<30	11,000	<30	150
	offshore	430	<30	<30	≥ 24,000	<30	90
Seaside :	Beach	11,000	30	210	2,400	<30	90
	offshore	≥ 24,000	930	4,600	2,400	<30	40
Monterey :	Beach	≥ 24,000	<30	40	11,000	<30	40
	offshore	≥ 24,000	11,000	≥ 24,000	≥ 24,000	<30	90
Pacific Grove:	Beach	(1) 24,000	<30	230	(2) 230	<30	40
	offshore	24,000	<30	230	230	<30	<30
Carmel :	Beach	2,400	<30	90	≥ 24,000	<30	<30
	offshore	≥ 24,000	<30	150	150	<30	<30

(1) County Health Department Data.

(2) Lovers Point to Government Pier.

Source: Monterey County Health Department, et.al., 1970.

* SWRCB Ocean Waters of California coliform standard for nearshore areas is 1,000 MPN/100 ml; RWQCB shellfish area standard is 70 MPN/100 ml.



NOTE – LENGTH OF DARKENED PORTION OF ARROW INDICATES MAGNITUDE

Figure E-1. SPECIFIC CONDUCTANCE CROSS-SECTION STATION 7 LOWER SALINAS RIVER*
DEC 9 1964

* Monitoring location #3 in Figure 6.

Source: California Department of Water Resources, 1965.

APPENDIX F

ARCHEOLOGY

APPENDIX F

MONTEREY PENINSULA REGIONAL WASTEWATER TREATMENT SYSTEM EXPANSION PROJECT

by

Tony F. Weber

and

Ann S. Peak

for

Ann S. Peak & Associates
Consulting Archeology

ANN S. PEAK & ASSOCIATES
CONSULTING ARCHEOLOGY

January 19, 1976

Jones & Stokes Associates
455 Capitol Mall
Sacramento, California

Gentlemen:

We are pleased to enclose herewith the final report on the Cultural Resource Assessment of the Monterey Peninsula Wastewater Treatment System Expansion Project.

The Antiquity Permit secured from the office of the Federal Secretary of the Interior, Washington, D.C., is included in the appendixes to the report, as is a letter to the History Preservation Section, California State Department of Parks and Recreation.

The report details survey results, field techniques, potential impact on archeological sites, and recommendations for mitigation.

It is believed that the report will be satisfactory in meeting local, state, and federal requirements having to do with identification and preservation of these non-renewable environmental resources.

As required by the Secretary of the Interior's office, six copies of the report have been submitted to Washington, D.C., and copies of the site survey form have been sent to the Bureau of Land Management office, Bakersfield, California.

Sincerely,

Ann S. Peak

Ann S. Peak

AP:CL

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APPENDIX 3. CONFIDENTIAL MATERIAL. Site Survey Form; Map 1, Archeological Site JS-MP-1

PLATES

MAPS 2-6

INTRODUCTION

The proposed project is the updating and improvement of the existing wastewater treatment systems of the Monterey Peninsula. The project includes expansion of existing plants, possible construction of new plants, and installation of intercepts and outfall lines.

Most of the project area lies in unstable dune areas or in older stabilized sand dunes east of the Bay. Vegetation varies from plant communities associated with the coastal area, riparian areas along the Salinas River, and rolling grasslands.

CULTURAL HISTORY

Indian

The Rumsen dialectic branch of the Costanoan people, part of the Penutian language family, occupied the area at the time of Spanish intrusion. The Costanoan territory extended from San Francisco Bay to near Point Sur. The inland boundaries are not precisely known because of lack of ethnographic data but are asserted or loosely assumed to be formed by the San Joaquin River, but far more probably the interior chain of the coast mountains, the Mount Diablo Range. The inland boundary problem is due primarily to early population displacement caused by Spanish missionization.

Although the settlement pattern of the Indian is only partially understood, it is known that major villages were usually located on bays near reliable sources of fresh water. Smaller ancillary villages and camps, presumably used for economic resource exploitation during the seasonal gathering cycles, are found along the coast and inland.

Economic subsistence along the coast naturally had a marine base--i.e., shellfish, fish, sea mammal, etc.--with augmentation of the diet through gathering of seeds and other vegetable foods. Where oaks were found, the acorn formed the primary plant food source (Kroeber 1925:467). Mammals and birds were hunted to further increase the diet base.

The Costonoan people were among the first Indian groups to be displaced by the missionization efforts of the Spanish. The cultural traditions of the natives were replaced by the new and unfamiliar ways of the explorers and mission fathers. Decimation of the Indian neophytes by disease further destroyed the old life-ways. Following secularization of the missions after the Mexican War of Independence, the mission lands were granted to settlers and the Indian residents dispersed. A few returned to their ancestral villages, but most remained near the old missions.

Previous archeological surveys near Monterey have recorded numerous prehistoric villages and campsites. The concentration of these lies predominantly along the coast southwards from the city. No sites are known to be situated on the coast northwards from Monterey toward the cities of Seaside and Marina. The density of sites suggests intensive aboriginal use and the depth of the cultural deposits indicates a long temporal span of occupation.

Spanish

Monterey Bay was first reached by a Portuguese navigator sailing under the Spanish flag. Don Juan Rodríguez Cabrillo set sail from Mexico, arriving in California waters in 1542. He entered Monterey Bay at Punta Piños, the present site of the city of Monterey. Heavy surf kept Cabrillo offshore and he never landed, but proceeded to explore as far as the Oregon coast.

In 1602, Sebastián Vizcaino, looking to find suitable harbor for ships of the Manila Galleon, left Mexico with three priests and a complement of men. The expedition spent two weeks surveying and mapping Monterey Bay and the surrounding area.

Costly wars and internal strife quelled Spain's interest in the New World for the following 150 years. However, Charles III became aware that the Russian fur traders were threatening encroachment on Spanish California. Gaspar de Portolá was commissioned to establish missions and presidios in Alta California.

In 1770, Portolá and Father Junipero Serra claimed the area for Charles III of Spain and the foundation for missions and presidios in Alta California had been laid. Father Serra moved the original mission San Carlos Borromeo from the presidio to the Carmel River. Serra's primary objectives were to Christianize the Indians and train them in the simple arts of civilization.

Juan Bautista de Anza led a land expedition from Mexico to Monterey, blazing a trail which colonists could travel overland to Monterey. Shortly, women and families began to arrive and Monterey began to look like a settlement.

In the following year, Monterey was named the capital of California. It lies at the center of the chain of missions which Father Serra had established from San Diego to San Francisco; therefore, it became the religious capital of California also.

In the period from 1782 to 1810, many of the colonists and military men were given large land grants. Monterey became quite self-sufficient, and somewhat isolated, during this time. No new colonists were arriving, due to the Yuman Indians cutting off de Anza's trail and Spain's not having the time or money to provision the small colony. In 1810, during Spain's South American revolution, Monterey was sacked by two Argentinian men-of-war, taking many months to rebuild.

After the Mexican war of independence, the capital was moved to Loreta.

American

In 1846 the United States acquired California from Mexico after its victory in the Mexican-American War. However, in October, 1842, Commodore Thomas Jones of the United States Navy sailed into Monterey Bay. He was under the impression that Mexico and the United States were at war, so he seized the port. After discovering that the war had not yet begun, he set out to undo his mistake by first lowering the American flag and then replacing it with the Mexican one. As he was sailing away, he fired a salute of apology.

At the outbreak of the Mexican-American War, Commodore John Sloat seized Monterey. He set anchor on July 2, 1846, landed his troops, and raised the American flag, encountering no resistance from the presidio. Commodore Sloat was later replaced by Robert Stockton, who appointed Walter Colton to act as the *alcalde*. After the shock of the invasion dimmed, the people of Monterey accepted the Americans, opening their doors to the new business.

After the seizure, the people of Monterey enjoyed peace and prosperity while the struggle for California was waged in the south. The surrender at Cahuenga on January 13, 1847, ended organized resistance to the American occupation, but it was not until another year that the peace treaty was signed and California became the property of the United States.

Nine days before signing of the Guadalupe Hidalgo Treaty, ending the Mexican-American War, gold was discovered in the foothills of the Sierra Nevada Mountains. Seemingly overnight, people from all over California were rushing to the gold fields. Monterey became a town of women, children, and others unable to make the trip to the mountains.

Now that California was a territory of the United States, much discussion centered around the need for a constitutional convention. Miners improvised their own government and therefore lacked tolerance for any other form. This led to much chaos and the need for a uniform government. Finally, in 1849, Bennett Riley, the new governor of California, issued a call for a constitutional convention.

The convention began in September, 1849, and was held in Monterey at Colton Hall. Forty-eight delegates, 10 from the southern district and 38 from the northern, met to form a constitution, with Robert Semple serving as president. Most of the delegates were Americans, with a handful of Californians. The principal issue of the convention concerned whether California would be a state or a territory. By a great majority, the delegates voted to form a state. In considering the question of slavery, the delegation decided that California would join the union as a free state. William Gwin and John Fremont were elected to represent California in the United States Senate.

After the convention, Monterey lost all of its prestige to San Francisco and San Jose. San Francisco, being much closer to the gold country, became a popular port and the center of business. With the advent of statehood, San Jose replaced Monterey as the political capital of California.

In the 1850s and 1860s, whaling became the major industry in Monterey. Then, in the 1900s, sarding fishing replaced whaling as the primary industry. By 1920, Monterey was the third largest fish tonnage port in the world, but by 1940 the catch began to decrease, thus forcing many of the companies out of business.

The new, quiet atmosphere of the town attracted artists, painters, and writers. Robert Louis Stevenson spent some time in Monterey and was there inspired to write his novel, Treasure Island. Other artists such as Charles Warren

Stoddard, Jules Tavernier, Joseph Strong, Julia Rix, and violinist Henry Heyman found the calm, tranquil town much to their liking.

Today Monterey houses much of California's heritage. People come from all over to see the mission in Carmel or the presidio six miles away. Many people enjoy wandering along Cannery Row, reliving the episodes of the old fishermen or the tales of John Steinbeck. Others enjoy the recreational centers which can be found throughout the peninsula. Still others travel the Seventeen Mile Route along the ocean, which encompasses some of the most beautiful sites one can imagine.

RESEARCH

Files and records of identified archeological sites were reviewed at the Cultural Resource Section, California Department of Parks and Recreation, and historical records were consulted at the History Preservation Section in that same agency.

A letter was requested from the California Department of Parks and Recreation concerning cultural resources (Appendix 2).

There were no identified archeological sites within the boundaries of the impact zones of the proposed project. Historical aspects of the region are well documented, although no historical features are noted in impact areas.

FIELD ASSESSMENT

All alternative alignments, treatment plant site alternatives, and existing plant sites (Maps 1-6) were traversed on foot by the two-person team of experienced archeologists. All ground surfaces were carefully examined for evidence of historic and prehistoric occupation/use. Where further definition was felt to be required, small trowel holes were dug to maximum depths of 25 centimeters (cm).

Where cultural evidence was found, these locations were plotted on the appropriate U.S.G.S. 7.5' topographic maps (Map 1) and a site survey form completed which detailed critical data on artifacts, extent of site, and its location (Appendix 3).

Lands under jurisdiction of the federal government (Fort Ord and the Naval Postgraduate School) required an Antiquity Permit to allow access (Appendix 1). Permission to enter was obtained from the proper authorities prior to actual field survey.

FIELD ASSESSMENT RESULTS

With one exception, there was no surface evidence of prehistoric sites within treatment plant sites or alternatives or along alternative routes. One probable prehistoric site (MS-MP-1) was located within the boundaries of the proposed Seaside Treatment Plant expansion (Map 1, Appendix 3).

The area of the site covers about 30 meters by 30 meters and is located on the western slopes of a small sand dune. Evidence of prehistoric habitation is sparse but there is sufficient content to consider it as a site.

Cultural material includes chert flakes, retouched flake scrapers, an obsidian flake, thermal fractured rock (broken cooking stone), shell fragments, and mammal bone fragments.

CONCLUSIONS

The presence of site JS-MP-1 is probably related to the available water source contained by the fresh water lagoons immediately south of the site location. Other sites may be present, but the unstable sand dunes of the survey area have perhaps concealed any surface evidence of prehistoric occupation.

The lack of sites in areas adjacent to the Salinas River on the secondary terraces cannot be explained. It may be that these areas were subject to periodic overflow of the river and were considered unstable by the Indian population.

MITIGATION

The area of JS-MP-1 (Map 1) should have further testing to allow an evaluation of significance of the site. It is strongly recommended that a minimum of three 1 x 2 meter units be excavated by a professional archeological firm. The analysis of recovered data will permit an evaluation of the site and allow the archeologist to develop specific recommendations concerning further disposition of the site.

Although no sites were identified in other areas of the project, much of the land is covered by active or older, stabilized sand dunes. The dunes may have buried other archeological sites, leaving no surface evidence of their location. It is recommended that construction be halted and a qualified archeologist be consulted for advice should unusual amounts of shell, bone, stone, or artifacts be uncovered during construction activities.

GROWTH INDUCEMENT

Should the construction of the project induce further urban growth, additional cultural resource assessments should be required by jurisdictional agencies as each land parcel is considered for development.

ADDENDUM

A second survey was initiated when four additional alternative outfall lines were considered. The alignments were traversed on foot by the archeologist, using the same techniques as the original survey. The alignments are delineated on Maps 3 and 6 and denoted 1 through 4.

Impacts

No cultural evidence was observed within the impact areas of the four new alternatives. However, as noted in the original report (page 8), sites may be buried beneath the unstable sand dunes, leaving no surface evidence.

Mitigation

Should unusual amounts of stone, shell, or bone be uncovered during construction, work should be halted and an archeologist retained to evaluate the situation.

REFERENCES

Adams, Kenneth. California Missions. Los Angeles: California Mission Trails Ass'n., Ltd., 1947.

Bancroft, Hubert. History of California. San Francisco: A. L. Bancroft and Co., 1884.

Carter, Charles. The Missions of Nueva California. San Francisco: Whitaker and Ray Company, 1900.

Chapman, Charles. A History of California: The Spanish Period. New York: The Macmillan Company, 1928.

Cleland, Robert. Pathfinders. San Francisco: Powell Publishing Company, 1929.

Del Monte Properties Company. The Seventeen Mile Drive, n.d.

Denis, Alberta. Spanish Alta California. New York: The Macmillan Company, 1927.

Elstob, Winston. Chinatown: A Legend of Old Cannery Row. Orinda, California: Condors Sky Press, 1965.

Engelhardt, Charles. The Missions and Missionaries of California. San Francisco: James H. Barry Co., 1912.

Fink, Augusta. Monterey. San Francisco: Chronicle Books, 1972.

Ford, Tirey. Dawn and the Dons. San Francisco: A. M. Robertson, 1926.

Hoover, Mildred, Hero E. Rensch, and Ethel G. Rensch. Historic Spots in California. 3d ed. Stanford: Stanford University Press, 1970.

Kroeber, A. L. 1925. Handbook of California Indians. Bureau of American Ethnology, Bulletin 78.

Powers, Laura. Old Monterey. San Francisco: San Carlos Press, 1934.

Wright, Agnes. "The Beginnings of Monterey." Master's thesis, University of California, Berkeley, 1931.

APPENDIX 1

Antiquity Permit

Form 10-71
(July 1971)

UNITED STATES DEPARTMENT OF THE INTERIOR

Please use this number when referring to this permit.

NO. 75-CA-111

ANTIQUITIES ACT PERMIT

To Conduct Work Upon Lands Owned or Controlled by the United States Under the Act For The Preservation of American Antiquities

(Approved June 8, 1906 (34 Stat. 225, 16 U.S.C. 432, 433) and the Regulations Thereunder)

1. PERMIT ISSUED TO:
California State University/Sacramento, California

DATE:
December 11, 1975

2. NAME, ADDRESS AND OFFICIAL STATUS OF PERSON:

a. In general charge:

Dr. Jerald J. Johnson
Department of Anthropology
California State University
Sacramento, California 95819

b. In actual direct charge:

Ann S. Peak
(address same as above)

3. UNDER APPLICATION DATED:
June 12, 1975

4. AUTHORIZES:
Archeological Investigations (Survey Only)

5. ON LANDS DESCRIBED AS FOLLOWS:
Department of Defense lands administered by the Department of the Army in the State of California: Fort Ord including sectors under controlled by the Department of the Navy (Naval Postgraduate School).

6. FOR PERIOD:
December 11, 1975 through January 10, 1976 (one month)

7. MATERIALS COLLECTED UNDER THIS PERMIT WILL BE DEPOSITED FOR PERMANENT PRESERVATION IN THE

California State University (Department of Anthropology)
Sacramento, California

OR IN OTHER ACCREDITED INSTITUTIONS UNDER SUITABLE LOAN AGREEMENTS.

8. SPECIAL CONDITIONS

This permit is subject to the provisions of the Act for the Preservation of American Antiquities approved June 8, 1906, and the interdepartmental regulations including 25 CFR 132, as to Indian lands, promulgated thereunder (copies attached), as well as the special conditions on the reverse of this form.

9. PRELIMINARY REPORT

Within approximately 6 weeks of the conclusion of field work, a preliminary report of work performed under this permit, illustrated with representative photographs and listing new and significant collected materials should be furnished the Secretary, Smithsonian Institution, and 6 copy(s) thereof should be forwarded to this Department.

DEPARTMENTAL CONSULTING ARCHEOLOGIST (Signature)

for Rex L. Wilson

/s/ Charles M. McKinney

8. (CONTINUED) SPECIAL CONDITIONS ARE CHECKED (X) AS APPROPRIATE TO THIS PERMIT

a. ☒ This permit shall not be exclusive in character, and there is hereby reserved unto the landowners the right to use, lease or permit the use of said land or any part thereof for any purpose.

b. ☒ Other institutions may be engaged in archeological research in the general area covered by this permit, and in case there should be conflict with respect to a site not specifically designated in a permit, the parties concerned shall reach agreement between themselves as to which shall work the site.

c. ☒ The Department of the Interior, including its bureaus and employees and the landowners and their grantees, shall be held blameless for any and all events, deeds or mishaps, regardless of whether or not they arise from operations under this permit.

d. ☒ Such guidance and protection as is consistent with the duties of the Department of the ~~Interior~~ Army/Navy official in charge of the area will be afforded the permit holder and his party.

e. ☒ Transportation in Department of the Interior vehicles cannot be furnished, except in cases where no extra expense to the Department is involved.

f. ☒ All costs shall be borne by the permittee.

g. ☒ The exploration or excavation of any Indian grave or burial ground on Indian lands and reservations under the jurisdiction of the Department of the Interior is restricted solely to qualified archeologists. No grave or burial ground abandoned less than 200 years may be investigated without permission of the governing council of the Indians concerned, which supplemental authority must be promptly recorded with the superintendent or other official in charge of the designated area.

h. ☐ All excavated areas shall be restored by filling in the excavations and otherwise leaving the area in as near to original condition as is practicable.

i. ☒ The permittee shall conduct all operations in such a manner as to prevent the erosion of the land, pollution of the water resources, and damage to the watershed, and to do all things necessary to prevent or reduce to the fullest extent the scarring of the lands.

j. ☒ Any findings of mined or processed precious metals or other treasure or treasure trove in the area covered by this permit are the exclusive property of the landowners, and shall not be disturbed or removed from the site without specific written permission from the Department of the ~~Interior~~. Army.

k. ☐ Before undertaking any work on lands administered by the Bureau of Land Management, clearance should be obtained from the Office of the State Director at ______________________________, and from the BLM District Officer in direct charge of the area concerned at ______________________________.

l. ☐ Before undertaking any work on lands administered by the Fish and Wildlife Service, clearance should be obtained from the Office of the Regional Director at ______________________________, and the Refuge Manager in charge at ______________________________. Possession or use of firearms in such areas is prohibited.

m. ☐ Before undertaking any work on lands administered by the Bureau of Reclamation, clearance should be obtained from the official in charge of the area.

n. ☐ Before undertaking any work on lands administered by the National Park Service, clearance should be obtained from the superintendent in charge of the area.

o. ☐ Before undertaking any work on Indian tribal lands or on individually owned trust or restricted Indian lands, clearance should be obtained from the Bureau of Indian Affairs official having immediate jurisdiction over the property at ______________________________

☒ Other special conditions continued on attached sheet(s).

APPENDIX 2

Communication with California Department of Parks and Recreation

ANN S. PEAK & ASSOCIATES
CONSULTING ARCHEOLOGY

October 15, 1975

Dr. Knox Mellin, Supervisor
History Preservation Section
Department of Parks and Recreation
P.O. Box 2290
Sacramento, California 95811

Dear Dr. Mellin:

As consultant to Jones & Stokes Associates, 455 Capitol Mall, Suite 835, Sacramento, California 95814, I wish to request information from your office on the cultural resources within the impact zones of the proposed Monterey Regional Wastewater Treatment System Project. Maps defining the proposed treatment plant sites and possible interceptor routes are enclosed for your information.

A recent field investigation found that there were no historic features within the impact areas. One possible prehistoric site was located within the boundaries of the proposed Seaside Treatment Plant site (Map 1). It has been recommended that test units be excavated here to allow evaluation of the site. There were no other sites previously recorded within the recent survey areas.

Sincerely,

Tony F. Weber

Tony F. Weber
Consulting Archeologist

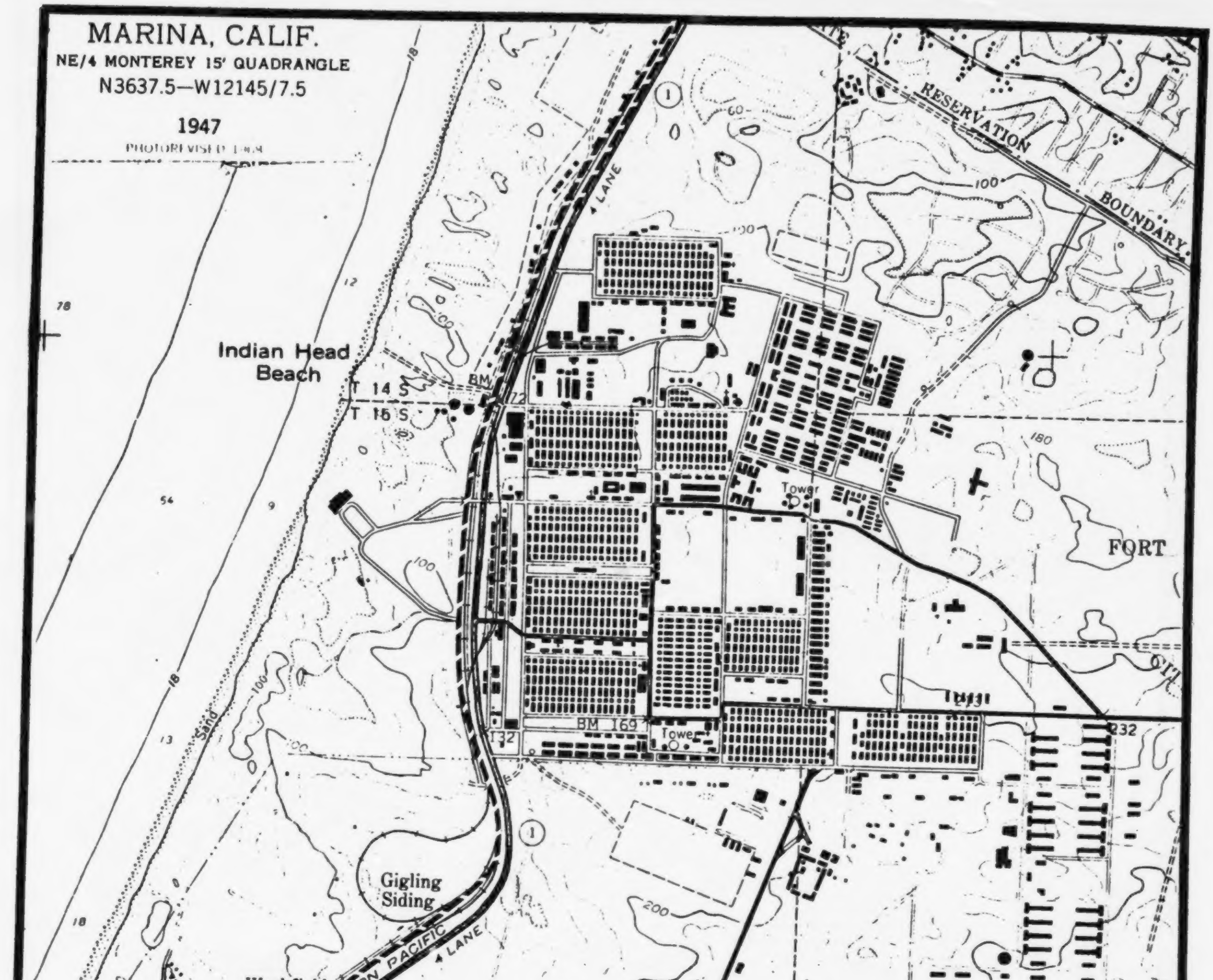
TW:CL
Encl.: Maps

8332 WILLOWDALE WAY - FAIR OAKS - CALIFORNIA - 95628 - (916) 967-3684

MAPS 2-6

▨ = Areas of survey

-------- = Alignments and alternative surveys



Published for civil use by the Geological Survey

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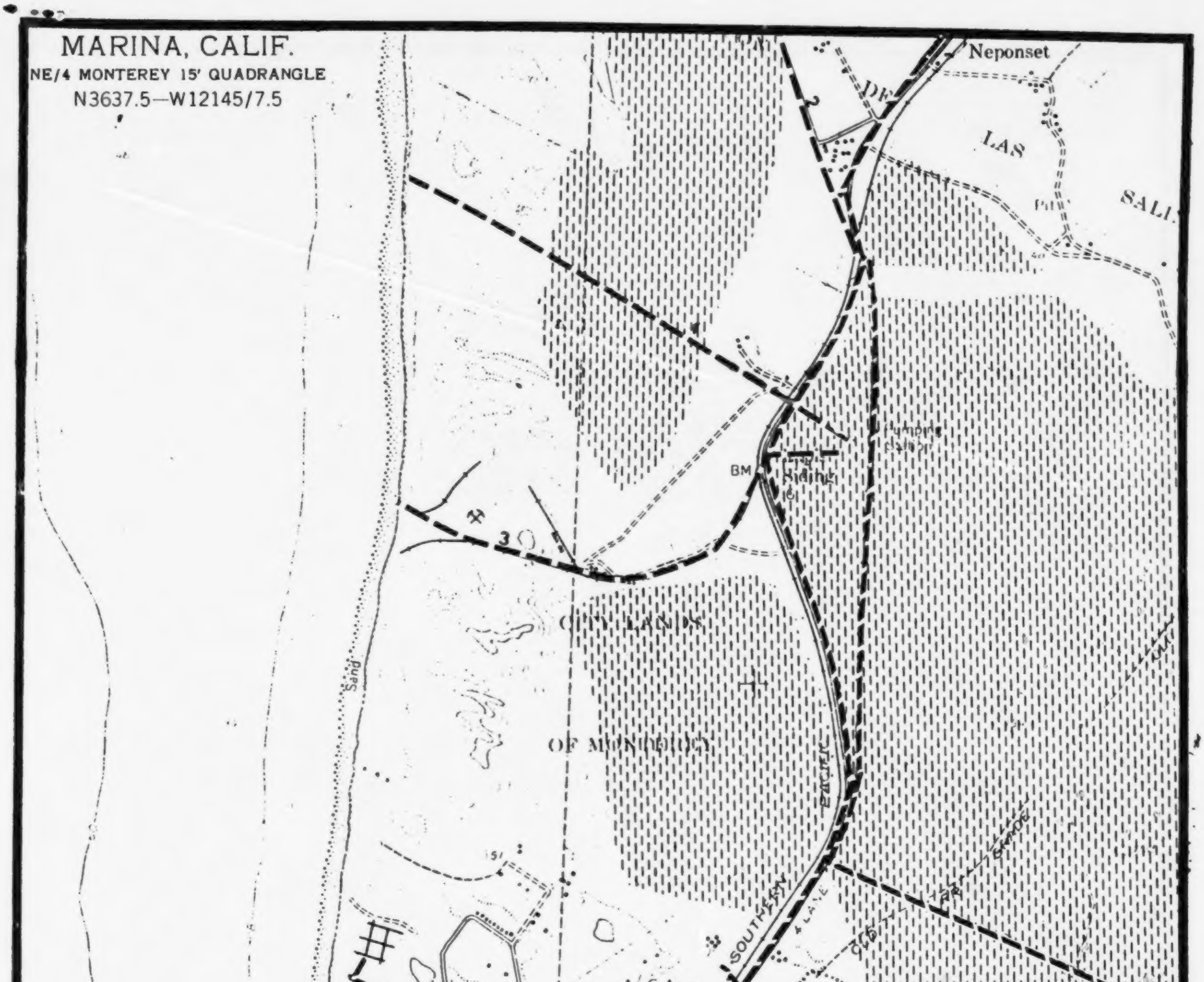
MAP 2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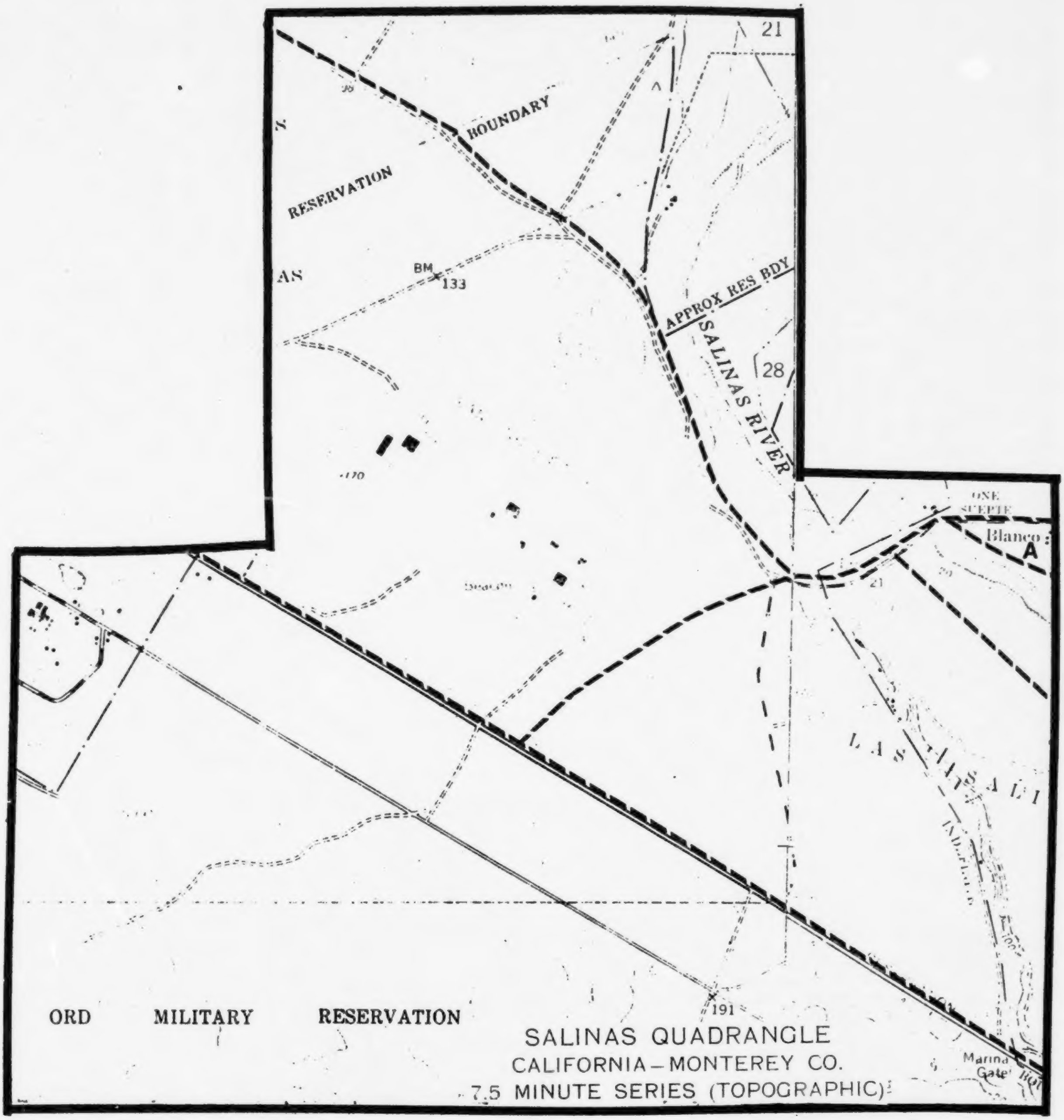
MAP 3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ONE SUERTE
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ORD MILITARY RESERVATION
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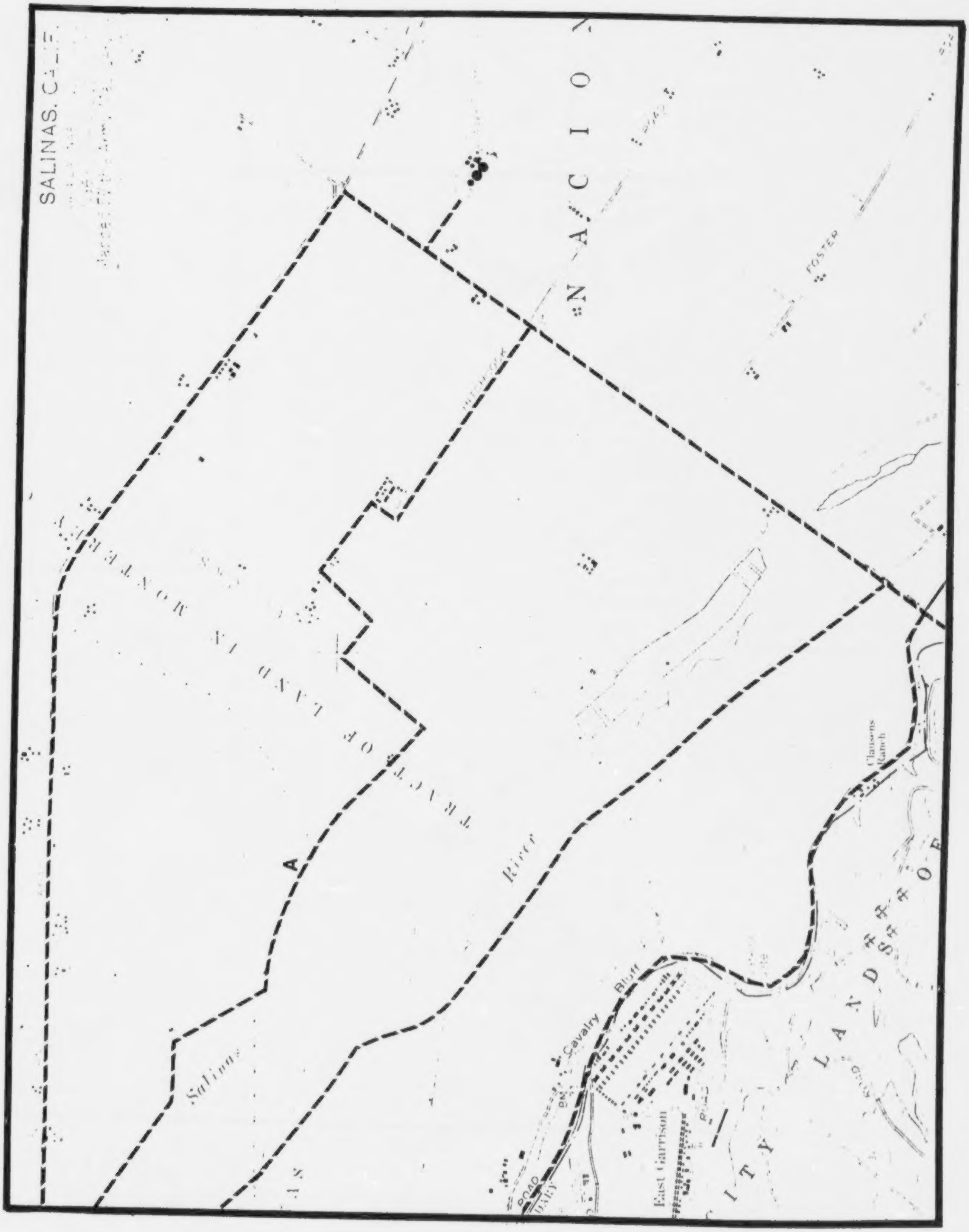
Marina Gate
SALINAS QUADRANGLE
CALIFORNIA – MONTEREY CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

MAP 4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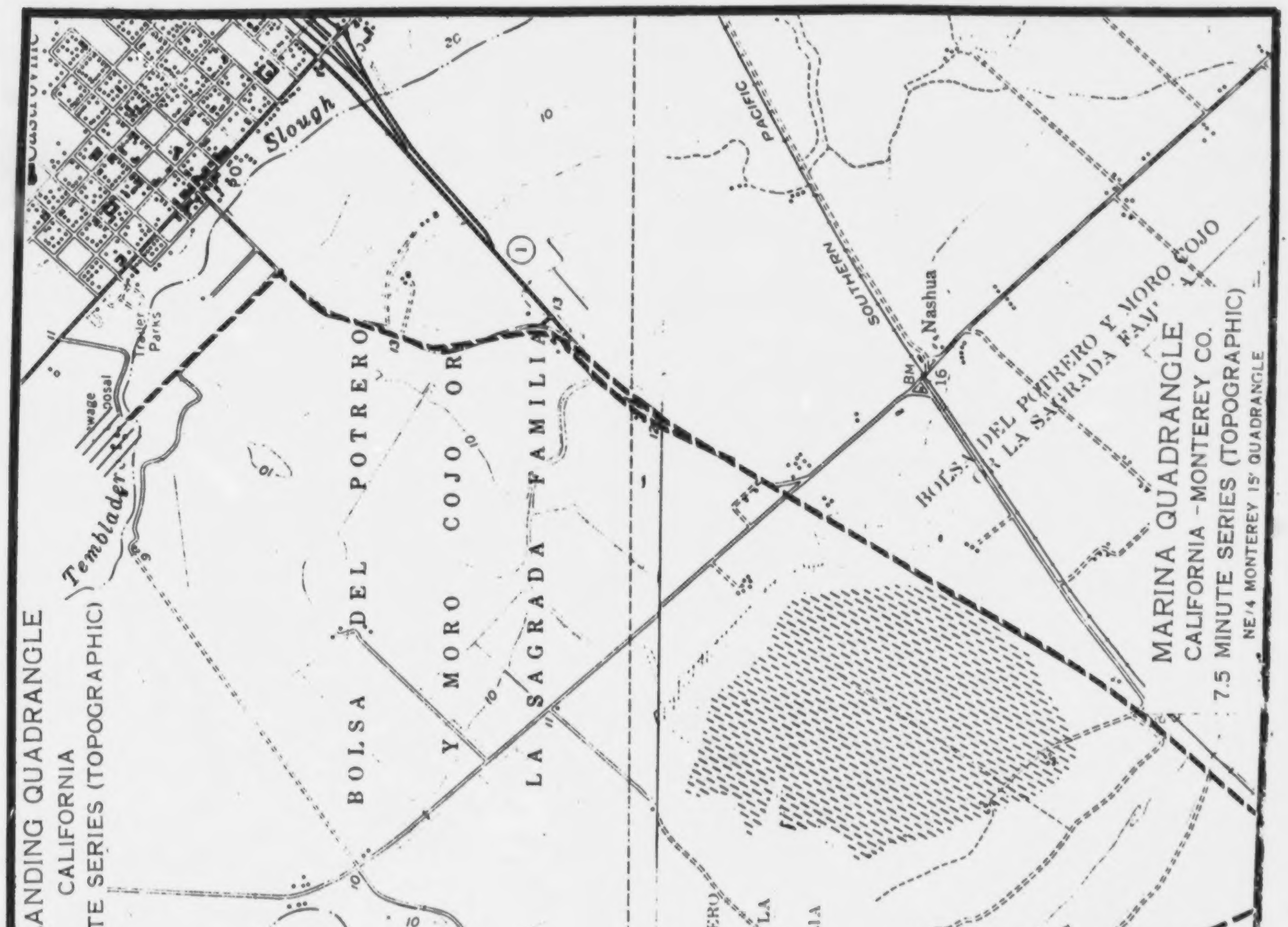
N A C I O N
FOSTER
TRACT OF LAND IN MONTEREY
A
Salinas
River
Clausens Ranch
Cavalry Bluff
East Garrison
ROAD
Daly
CITY LANDS OF

MAP 5


MOSS LANDING QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
MARINA QUADRANGLE
CALIFORNIA -MONTEREY CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 MONTEREY 15' QUADRANGLE
BOLSA DEL POTRERO Y MORO COJO OR LA SAGRADA FAMILIA
BOLSA DEL POTRERO Y MORO COJO OR LA SAGRADA FAMILIA
BOLSA DEL POTRERO Y MORO COJO OR LA SAGRADA FAM.
SOUTHERN PACIFIC
Nashua
Slough
Tembladero
Trailer Parks
Sewage Disposal
OLD
RINCON DE LAS SAL
SALINAS
Tower
Mulligan Hills
QUADRANGLE LOCATION
CALIF
①
1
2

MAP 6

ADDENDUM 1

CULTURAL RESOURCE ASSESSMENT OF THE INTERCEPTOR LINE -- EAST OF BLANCO ROAD AND WEST OF DAVIS ROAD.

(Augmentation of Monterey
Peninsula Regional Wastewater
Treatment System)

July 1, 1976

by

Ann S. Peak & Associates

INTRODUCTION

The present report covers the cultural resource assessment of an alternative interceptor line (See A on Maps 4 and 5 of original report). Location of the proposed Alternative Line is north of the Salinas River east of the Blanco Road Bridge and west of Davis Road on the 7.5' U.S.G.S. topographic map Salinas, California.

The Alternative Alignment Assessment report will be appended to the original report (Weber and Peak, 1976). As the previous work included a regional record research of cultural resources and a development of the cultural history, these sections will not be repeated in the Appendix.

FIELD ASSESSMENT AND RESULTS

The new Interceptor Alternative was traversed on foot by the two-person team of archeologists. The western extent of the alignment follows the existing Hitchcock Road and then continues southwesterly along dirt roads to terminate near the Salinas River crossing of Blanco Road. The entire land area adjoining Hitchcock Road and the dirt roads is under cultivation and this appears to be a condition of long-standing.

No evidence of archeological sites or historic features was observed within or adjacent to the potential impact zone.

IMPACT

There will be no impact on identified cultural resources. There is the possibility that the extensive conversion of the land for agriculture has obscured unknown archeological sites. These may be covered by culturally sterile soils and show no surface evidence of their existence. The construction procedures for installation of the pipelines might expose a buried site or sites and impact portions of the cultural deposit.

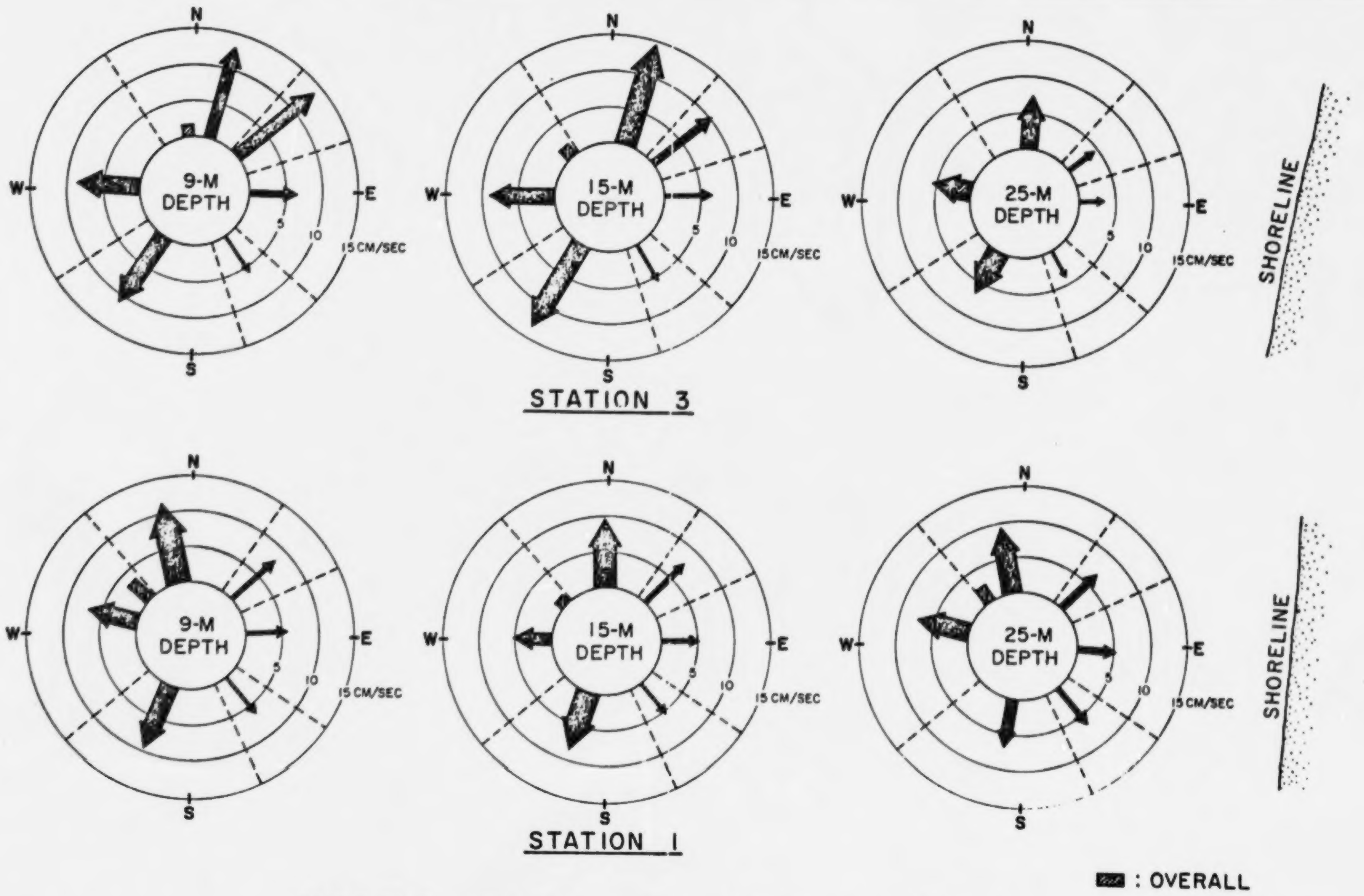
RECOMMENDATIONS

Should a buried site be exposed during construction, work should be halted and the archeologist retained to assess the situation and make specific recommendations for mitigation.

An archeological site might be identified by unusual amounts of sea shell, bone, stone tools, artifacts, or human bone.

APPENDIX G

MONTEREY BAY CURRENTS



CURRENT VECTOR RESULTANTS BY SECTOR

Figure G-1

Source: Engineering Science, Inc., 1976f.

Table G-1

STATISTICAL SUMMARY OF METERED CURRENTS AT STATION 1

Parameter	Sector Onshore	Onshore Upcoast	Onshore Downcoast	Upcoast	Down-coast	Offshore
9-m Depth (20 January 1976 - 22 July 1976)						
Distribution of Speed, cm/sec						
Percentile: 10	2.4	2.9	3.1	4.4	3.3	2.2
20	3.6	4.8	4.2	6.9	5.6	4.2
30	4.5	6.1	5.1	8.8	7.3	5.7
40	5.3	7.3	5.8	10.3	8.8	6.9
50	6.0	8.3	6.5	11.8	10.1	8.1
60	6.7	9.4	7.2	13.3	11.4	9.2
70	7.5	10.5	7.9	14.8	12.8	10.4
80	8.4	11.9	8.8	16.7	14.5	11.9
90	9.6	13.7	10.0	19.2	16.9	13.9
Standard Deviation	2.8	4.2	2.7	5.8	5.3	4.6
Number of Observations	467	528	253	2,700	1,852	1,954
Frequency of Occurrence, %	6.0	6.8	3.3	34.8	23.9	25.2
15-m Depth (20 January 1976 - 19 April 1976)						
Distribution of Speed, cm/sec						
Percentile: 10	2.4	3.1	2.3	3.6	3.3	0.9
20	3.5	4.7	3.4	5.9	5.2	2.7
30	4.3	5.9	4.1	7.6	6.7	4.0
40	5.0	6.9	4.8	9.0	7.9	5.1
50	5.6	7.8	5.3	10.4	9.0	6.1
60	6.2	8.7	5.9	11.7	10.1	7.2
70	6.8	9.7	6.6	13.1	11.3	8.3
80	7.6	10.8	7.3	14.8	12.7	9.6
90	8.7	12.4	8.4	17.1	14.6	11.4
Standard Deviation	2.5	3.6	2.4	5.3	4.4	4.1
Number of Observations	240	280	152	1,139	1,147	679
Frequency of Occurrence, %	6.6	7.7	4.2	31.3	31.5	18.7
25-m Depth (19 April 1976 - 22 July 1976)						
Distribution of Speed, cm/sec						
Percentile: 10	2.1	2.5	2.3	3.9	2.4	2.6
20	3.3	4.0	3.8	5.9	4.2	4.5
30	4.1	5.1	4.8	7.4	5.4	6.0
40	4.8	6.0	5.7	8.6	6.5	7.2
50	5.5	6.9	6.5	9.7	7.4	8.3
60	6.2	7.8	7.4	10.8	8.4	9.4
70	6.9	8.7	8.3	12.0	9.5	10.6
80	7.7	9.8	9.3	13.5	10.7	12.0
90	8.9	11.3	10.8	15.5	12.4	14.0
Standard Deviation	2.7	3.5	3.3	4.5	3.9	4.5
Number of Observations	442	398	261	1,147	691	1,175
Frequency of Occurrence, %	10.7	9.7	6.3	27.9	16.8	28.6

Source: Engineering Science, Inc., 1976f.

Table G-2

STATISTICAL SUMMARY OF METERED CURRENTS AT STATION 3

Parameter	Sector					
	Onshore	Onshore Upcoast	Onshore Downcoast	Upcoast	Down-coast	Offshore
9-m Depth (20 January 1976 - 22 July 1976)						
Distribution of Speed, cm/sec						
Percentile: 10	0.8	3.4	1.3	1.8	2.2	1.4
20	3.0	7.0	3.0	6.1	5.5	4.2
30	4.5	9.6	4.2	9.2	7.8	6.3
40	5.8	11.8	5.2	11.8	9.8	8.0
50	7.0	13.9	6.2	14.3	11.6	9.6
60	8.2	15.9	7.1	16.7	13.4	11.2
70	9.5	18.2	8.1	19.3	15.4	13.0
80	11.0	20.8	9.3	22.5	17.7	15.0
90	13.1	24.4	11.0	26.7	21.0	17.9
Standard Deviation	4.8	8.2	3.8	9.7	7.3	6.4
Number of Observations	730	1,660	256	1,550	2,126	2,080
Frequency of Occurrence, %	8.7	19.8	3.0	18.4	25.3	24.8
15-m Depth (20 January 1976 - 19 April 1976)						
Distribution of Speed, cm/sec						
Percentile: 10	2.4	3.5	2.4	4.5	4.9	2.3
20	3.9	5.9	3.6	8.3	8.0	5.0
30	5.0	7.6	4.4	11.1	10.3	7.1
40	5.9	9.0	5.1	13.4	12.2	8.8
50	6.7	10.3	5.8	15.5	14.0	10.3
60	7.6	11.7	6.5	17.7	15.8	11.9
70	8.5	13.1	7.2	20.0	17.7	13.6
80	9.6	14.8	8.0	22.7	20.0	15.7
90	11.0	17.2	9.2	26.5	23.1	18.4
Standard Deviation	3.4	5.3	2.6	8.6	7.1	6.3
Number of Observations	272	432	153	1,314	1,253	872
Frequency of Occurrence, %	6.3	10.0	3.6	30.6	29.2	20.3
25-m Depth (19 April 1976 - 22 July 1976)						
Distribution of Speed, cm/sec						
Percentile: 10	0.0	0.0	0.0	0.0	0.0	0.0
20	0.7	0.5	1.1	0.7	1.5	1.0
30	1.8	2.1	2.3	3.5	3.6	3.0
40	2.8	3.4	3.3	5.8	5.3	4.6
50	3.7	4.6	4.2	8.0	6.9	6.1
60	4.6	5.9	5.1	10.2	8.5	7.6
70	5.5	7.2	6.1	12.5	10.2	9.2
80	6.7	8.8	7.3	15.3	12.2	11.1
90	8.3	10.9	8.9	19.1	15.0	13.6
Standard Deviation	3.6	4.9	3.7	8.7	6.4	6.0
Number of Observations	191	268	146	1,032	1,280	1,211
Frequency of Occurrence, %	4.6	6.6	3.5	25.0	31.0	29.3

Source: Engineering Science, Inc., 1976f.

BACKGROUND DATA -- BIOLOGICAL ENVIRONMENT

APPENDIX H

TERRESTRIAL BIOTA

Table H-1

SALINAS RIVER RIPARIAN PLANT SPECIES COMPOSITION

Common Name	Scientific Name
	Shrubs
Quail bush	*Atriplex lentiformis*
Allscale	*A. polycarpa*
Coyote bush	*Baccharis pilularis*
Mule fat	*B. viminea*
Tree tobacco	*Nicotiana glauca*
Current	*Ribes* spp.
Rose	*Rosa* spp.
Bush lupine	*Lupinus* spp.
Poison oak	*Rhus diversiloba*
Squaw bush	*R. trilobata*
Sage	*Salvia* spp.
Willow	*Salix* spp.
	Trees
Califoria box elder	*Acer negundo*
White alder	*Alnus rhombifolia*
Red alder	*A. rubra*
Western sycamore	*Plantanus racemosa*
Fremont cottonwood	*Populus fremontii*
Black cottonwood	*P. trichocarpa*
Coast live oak	*Quercus agrifolia*
Valley oak	*Q. lobata*
Scouler willow	*Salix scouleriana*
Willow	*Salix* spp.
Blue elderberry	*Sambucus caerulea*

Source: California Department of Fish and Game, Monterey, California, unpublished data.

Table H-2

SALINAS RIVER RIPARIAN VEGETATION SUBTYPE SURVEY

	(Vegetative Subtype (Acreage)									
Area Surveyed	Shrub-Herbaceous	Herbaceous	Shrub	Tree-Shrub	Tree-Herbaceous	Tree No Understory	Fresh Water Marsh	Salt Water Marsh	Total	Riparian Acreage Per Mile
Chualar Bridge to Salinas (Alisal) sewage treatment plant outfall (14 linear miles)	599	250	169	470	19	3	0	0	1,510	108
Salinas (Alisal) sewage treatment plant outfall to Pacific Ocean (10 linear miles)	338	141	38	360	0	0	2	63	942	88
Total Acreage/Subtype	937	391	207	830	19	3	2	63	2,452	102

Source: California Department of Fish and Game, Monterey, California, unpublished data.

Table H-3

FISH CAPTURED OR OBSERVED IN THE SALINAS RIVER LAGOON

Common Name	Scientific Name	Months of Capture or Observation
Striped bass	*Morone saxatilis*	July, September
Starry flounder	*Platichthys stellatus*	July
Carp	*Cyprinus carpio*	July, September
Sacramento hitch	*Lavinia exilicauda*	July
Sacramento blackfish	*Orthodon microlepidotus*	July, September
Green sturgeon	*Acipenser medirostris*	July
Sucker	*Catostomus* sp.	September
Sacramento squawfish	*Ptychocheilus grandis*	September
Top smelt	*Atherinops affinis*	December
Staghorn sculpin	*Leptocottus armatus*	December
Three-spine stickleback	*Gasterosteus aculeatus*	December
Shiner perch	*Cymato gaster aggregata*	December
Pacific herring	*Clupea harengus pallasi*	December
Pipefish	(Species Unknown)	December
Steelhead trout	*Salmo gairdnerii gairdnerii*	December

Source: California Department of Fish and Game, unpublished data; Snider, pers. comm.

Table H-4

FAUNAL LIST

Mammals

Oppssum (Didelphis marsupialis)
Throwbridge Shrew (Sorex trowbridgei)
Ornate Shrew (Sorex ornatus)
California Mole (Scapanus latimanus)
Little Brown Myotis (Myotis lucifugus)
Fringed Myotis (Myotis thysanodes)
Long-eared Myotis (Myotis evotis)
California Myotis (Myotis californicus)
Yuma Myotis (Myotis yumanensis)
Long-legged Myotis (Myotis volans)
Silver-haired Bat (Lasionycteris notivagans)
Western Pipistrel (Pipistrellus hesperus)
Red Bat (Lasiurus borealis)
Big Brown Bat (Eptesicus fuscus)
Hoary Bat (Lasiurus cinereus)
Western Big-eared Bat (Plecotus townsendi)
Western Mastiff Bat (Emops perotis)
Pallid Bat (Antrozous pallidus)
Mexican Freetail Bat (Tadarida brasiliensis)
Racoon (Procyon lotor)
Ringtail (Bassariscus astutus)
Longtail Weasel (Mustela frenata)
Badger (Taxidea taxus)
Spotted Skunk (Spilogale putorius)
Striped Skunk (Mephitis mephitis)
Coyote(Canis latrans)
Grey Fox (Urocyon cinereoargenteus)
Mountain Lion (Felis concolor)
Bobcat (Lynx rufus)
California Ground Squirrel (Citellus beecheyi)
Merriam Chipmunk (Eutamias merriami)
Western Grey Squirrel (Sciurus griseus)
Valley Pocket Gopher (Thomomys bottae)
California Pocket Mouse (Perognatus californicus)
Heerman Kangaroo Rat (Dipodomys heermanni)
Santa Cruz Kangaroo Rat (Dipodomys venustus)
Beaver (Castor canadensis)
Western Harvest Mouse (Reithrodontomys megalotis)
California Mouse (Peromyscus californicus)
Deer Mouse (Peromyscus maniculatus)
Brush Mouse (Peromyscus boylei)
Pinon Mouse (Peromyscus truei)
Dusky-Footed Woodrat (Neotoma fuscipes)
California Vole (Microtus californicus)
Muskrat (Ondatra zibethica)
Norway Rat (Rattus norvegicus)
House Mouse (Mus musculus)
Blacktail Jackrabbit (Lepus californicus)

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Desert Cottontail (Sylvilagus auduboni)
Brush Rabbit (Sylvilagus bachmani)
Wild Boar (Sus scrofa)
Mule Deer (Odocoileus hemionus)

Reptiles and Amphibians

Pacific Giant Salamander (Dicamptodon ensatus)
Tiger Salamander (Amtystoma tigrinum)
Rough-skinned Newt (Taricha granulose)
Ensatina (Ensatina eschscholtzi)
California Slender Salamander (Batrachoseps attenuatus)
Arboreal Salamander(Aneides lugubris)
Western Spadefoot (Scaphiopus hammondi)
Western Toad (Bufo boreas)
Pacific Treefrog (Hyla regilla)
Red-legged Frog (Rana aurora)
Bullfrog (Rana catesbeiana)
Foothill Yellow-legged Frog (Rana boylei)
Western Pond Turtle (Clymmys marmorata)
Western Fence Lizzard (Sceloporus occidentalis)
Sagebrush Lizzard (Sceloporus graciosus)
Side-blotched Lizzard (Uta stansburiana)
Coast Horned Lizzard (Phrynosoma coronatum)
Western Skink (Eumeces skiltonianus)
Western Whiptail (Cnemidophorus tigris)
Southern Aligator Lizzard (Gerrhonotus multicarinatus)
Northern Aligator Lizzard (Gerrhonotus coeruleus)
California Legless Lizzard (Anniella pulchra)
Rubber Boa (Charina bottae)
Ringneck Snake (Diadophus punctatus)
Sharp-tailed Snake (Contia tenis)
Striped Racer (Masticophis lateralis)
Coachwhip (Masticophis flagellum)
Racer (Coluber constrictor)
Gopher Snake (Pituophis melanoleucus)
California Mountain Kingsnake (Kempropeltis zonta)
Common Kingsnake (Lampropeltis getulus)
Common Garter Snake (Thamnophis sirtalis)
Western Terrestial Garter Snake (Thamnopsis elegans)
Western Aquatic Garter Snake (Thamnopsis couchi)
Night Snake (Hypsiglena torquata)
Western Rattlesnake (Crotalus viridis)

Birds

Pied-billed Grebe (Podilymbus podiceps)
Waterfowl (Potential Breeders only)
  Mallard (Anas platyrhynchos)
  Pintail (Anas acuta)

    Gadwall (Anas strepera)
    Sholver (Spatual clypeata)
    Wood Duck (Aix sponsa)
    Common Merganser (Mergus merganser)
    Cinnamon Teal (Anas cyanoptera)
    Ruddy Duck (Oxyura jamaicensis)
Turkey Vulture (Cathartes aura)
California Condor (Gymnogyps californianus)*
White-tailed Kite (Elanus leucurus)
Cooper's Hawk (Accipter cooperii)
Sharp-shinned Hawk (Accipter striatus)
Marsh Hawk (Circus syaneus)
Rough-legged Hawk (Buteo lagopus)
Ferruginous Hawk (Buteo regalis)
Red-tailed Hawk (Buteo jamaicensis)
Red-shouldered Hawk (Buteo lineatus)
Swainson's Hawk (Buteo swainsoni)
Golden Eagle (Aquila chrysaetos)
Bald Eagle (Haliaeetus leucocephalus)*
Osprey (Pandion haliaetus)
Prairie Falcon (Falco mexicanus)
Peregrine Falcon (Falco peregrinus)*
Pigeon Hawk (Falco columbarius)
Sparrow Hawk (Falco sparverius)
California Quail (Lophortyx californicus)
Mountain Quail (Oreortyx pictus)
Ring-necked Pheasant (Phasianus colchicus)
Turkey (Meleagris gallopavo)
Sandhill Crane (Grus canadensis)
Common Egret (Casmerodius albus)
Snowy Egret (Leucophoyx thula)
Great Blue Heron (Ardea herodias)
Green Heron (Butorides virescens)
Black-crown Night Heron (Nycticorax nycticorax)
American Bittern (Botaurus lentiginosus)
Least Bittern (Ixobrychus exilis)
Virginia Rail (Rallus limicola)
Sora (Porzana carolina)
Yellow Rail (Coturnicops noveboracensis)
Black Rail (Laterallus jamaicensis)
Common Gallinule (Gallinula chloropus)
American Coot (Fulica americana)
Killdeer (Charadrius vociferus)
Common Snipe(Capella gallinago)
Long-billed Curlew (Numenius americanus)
American Avocet (Recurvirostra americana)
Herring Gull (Larus argentatus)
California Gull (Larus californicus)
Ring-billed Gull (Larus delawarensis)
Mew Gull (Larus canus)
Caspain Tern (Hydroprogne caspia)

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Band-tailed Pigeon (Columba fasciata)
Mourning Dove (Zenaidura macroura)
Yellow-billed Cuckoo (Coccyzus americanus)
Screech Owl (Otus asio)
Great Horned Owl (Bubo virginianus)
Short-eared Owl (Asio flammeus)
Barn Owl (Tyto alba)
Burrowing Owl (Speotyto cunicularia)
Pygmy Owl (Glaucidium gnoma)
Poor-will (Phalaenoptilus nuttallii)
Common Nighthawk (Chordeiles minor)
Vaux's Swift (Chaetura vauxi)
White-throated Swift (Aeronautes saxatalis)
Anna's Hummingbird (Calypte anna)
Black-chinned Hummingbird (Archilochus alexandri)
Rufous Hummingbird (Selasphorus rufus)
Allen's Hummingbird (Selasphorus sasin)
Belted Kingfisher (Megaceryle alcyon)
Red-shafted Flicker (Colaptes cafer)
Nuttall's Woodpecker (Dendrocopos nuttallii)
Acorn Woodpecker (Melanerpes formicivorus)
Lewis' Woodpecker (Asyndesmus lewis)
Yellow-bellied Sapsucker (Sphyrapicus varius)
Downy Woodpecker (Dendrocopos pubescens)
Western Kingbird (Tyrannus ~~vociferans)~~ verticalis)
Ash-throated Flycatcher (Myiarchus cinerascens)
Black Phobe (Sayornis nigricans)
Western Flycatcher (Empidonax difficilis)
Western Wood Pewee (Contopus sordidulus)
Horned Lark (Eremophila alpestris)
Barn Swallow (Hirundo rustica)
Cliff Swallow (Petrochelidon pyrrhonota)
Violet-Green Swallow (Tachycineta thalassina)
Tree Swallow (Iridoprocne bicolor)
Bank Swallow (Riparia riparia)
Rough-wing Swallow (Stelgidopteryx ruficollis)
Purple Martin (Progne subis)
Steller's Jay (Cyanocilla stelleri)
Scrub Jay (Aphelocoma coerulescens)
Yellow-billed Magpie (Pica nuttalli)
Common Raven (Corvus corax)
Common Crow (Corvus caurinus)
Chestnut-backed Chickadee (Parus rufescens)
Plain Titmouse (Parus inornatus)
Common Bushtit (Psaltriparus minimus)
Wrentit (Chamaea fasciata)
Brown Creeper (Certaia familiars)
Dipper (Cinclus mexicanus)
White-breasted Nuthatch (Sitta carolinensis)
Red-breasted Nuthatch (Sitta canadensis)
House Wren(Troglodytes aedon)
Bewick's Wren (Thryomanes bewickii)
Rock Wren (Salpinctes obsoletus)

Canyon Wren (Catherpes mexicanus)
Long-billed Marsh Wren (Telmatodytes palustris)
Mockingbird (Mimus poluglottos)
California Thrasher (Toxostoma redivivum)
Robin (Turdus migratorius)
Varied Thrush (Ixoreus naevius)
Townsend's Solitaire (Myadestes townsendi)
Hermit Thrush (Hylocichla guttata)
Swainson's Thrush (Hylocichla ustulata)
Western Bluebird (Sialia mexicana)
Blue-Gray Gnatcatcher (Polioptila caerulea)
Ruby-crowned Kinglet (Regulus calendula)
Water Pipit (Anthus spinoletta)
Cedar Waxwing (Bombycilla cedrorum)
Phainopepla (Phainopepla nitens)
Loggerhead Shrike (Lanius ludovicianus)
Starling (Sturnus vulgaris)
Solitary Vireo (Vireo solitarius)
Bell's Vireo (Vireo bellii)
Hutton's Vireo (Vireo huttoni)
Warbling Vireo (Vireo gilvus)
Orange-crowned Warbler (Vermivora celata)
Nashville Warbler (Vermivora ruficapilla)
Yellow Warbler (Dendroica petechia)
Myrtle Warbler (Dendroica coronata)
Audubon's Warbler (Dendroica auduboni)
Townsend's Warbler (Dendroica townsendi)
Hermit Warbler (Dendroica occidentalis)
Black-throated Grey Warbler (Dendroica nigrescens)
Grace's Warbler (Dendroica graciae)
Yellowthroat (Geothlypis trichas)
Yellow-breasted Chat (Icteria virens)
MacGillivary's Warbler (Oporornis tolmiei)
Wilson's Warbler (Wilsonia pusilla)
House Sparrow (Passer domesticus)
Western Meadowlark (Sturnella neglecta)
Yellow-headed Blackbird (Xanthocephalus xanthocephalus)
Red-Winged Blackbird (Agelaius phoeniceus)
Tricolored Blackbird (Agelaius tricolor)
Brewer's Blackbird (Euphagus cyanocephalus)
Brown-headed Cowbird (Molothrus ater)
Baltimore (Bullock's) Oriole (Icterus galbula bullockii)
Western Tanager (Piranga ludoviciana)
Black-headed Grosebeak (Pheucticus melanocephalus)
Blue Grosebeak (~~Blue grosebeak~~ (Guiraca caerulea)
Lazuli Bunting (Passerina amoena)
Purple Finch (Carpodacus purpureus)
Houes Finch (Carpodacus mexicanus)
Pine Siskin (Spinus pinus)
American Goldfinch (Spinus tristis)
Lesser Goldfinch (Spinus psaltria)
Green-tailed Tohee (Chlorura chlorura)

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Rufous-sided Towhee (Pipilo erythrophthalmus)
Savannah Sparrow (Passerculus sandwichensis)
Grasshopper Sparrow (Ammodramus savannarum)
Vesper Sparrow (XXXXXXXXXXX (Pooecetes gramineus)
Lark Sparrow (Chondestes grammacus)
Sage Sparrow (Amphispiza belli)
Slate-colored Junco (Junco hyemalis)
Oregon Junco (Junco oreganus)
Chipping Sparrow (Spizella passerina)
White-crowned Sparrow (Zonotrichia leucophrys)
Golden-crowned Sparrow (Zonotrichia atricapilla)
White-throated Sparrow (Zonotrichia albicollis)
Fox Sparrow (Passerella iliaca)
Lincoln's Sparrow (Melospiza lincolnii)
Song Sparrow (Melospiza melodia)

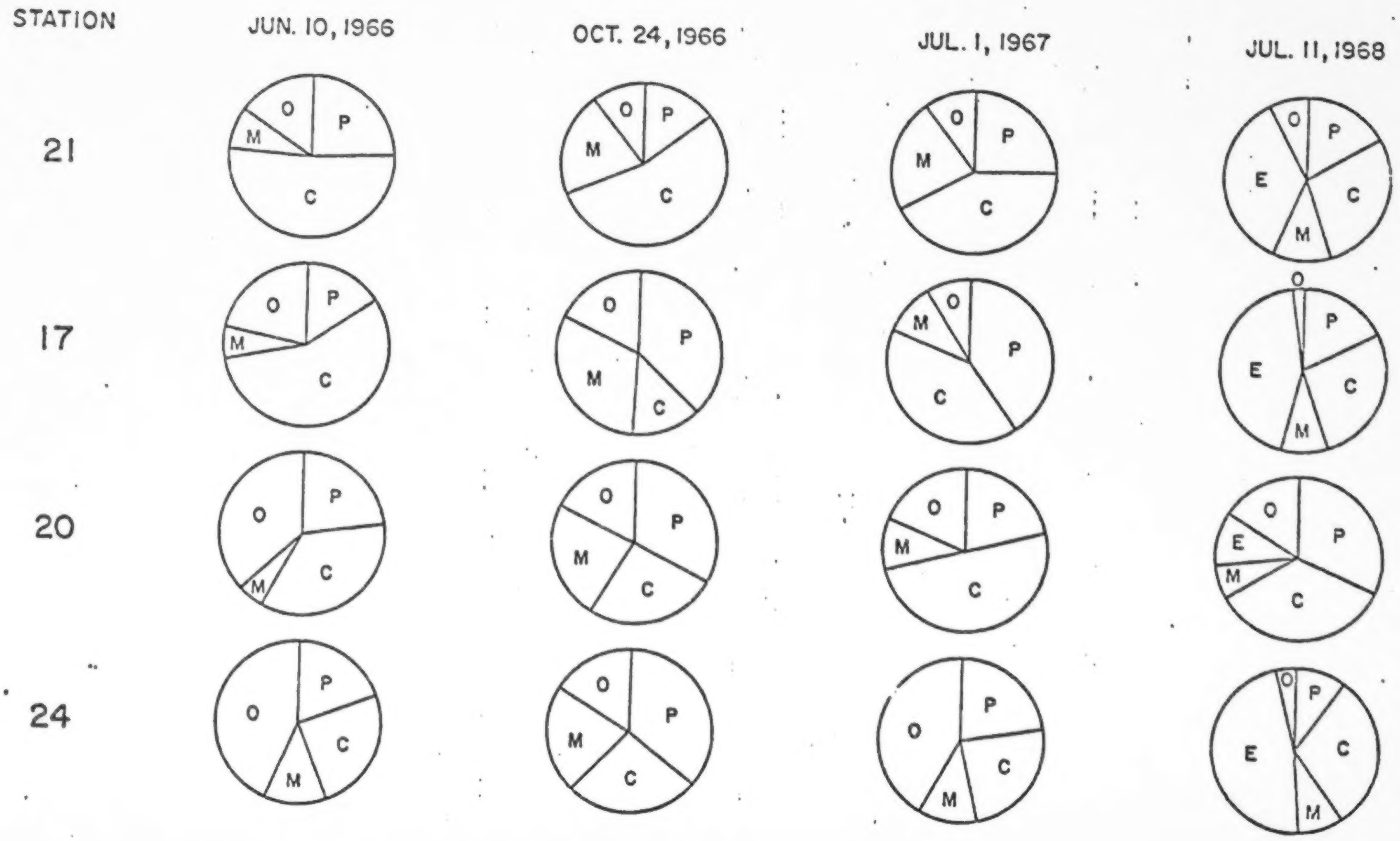
Source: California Department of Fish and Game, pers. comm.

* Species listed as rare and endangered under the California Endangered Species Act of 1970 and Sections 2050-2055 of the Fish and Game Code.

APPENDIX I

MARINE BIOTA

Figure I-1



BENTHIC STATION DATA, MONTEREY BAY

Station Composition by Major Taxonomic Groups:
P-Polychaeta, E-Echinodermata, C-Crustacea, M-Mollusca, O-Other Taxa

Sources: Chartock, PG&E Studies; Engineering Science, Inc., 1975a.

Table I-1. Characteristic shallow water benthos, southern Monterey Bay *

Station 17, 5,200' S. of Moss Landing, 8½ fathoms. (48')

June 10, 1066 Taxon	% com.	$\bar{x}$/kg	October 24, 1966 Taxon	% com.	$\bar{x}$/kg	July 1, 1967 Taxon	% com.	$\bar{x}$/kg	July 11, 1968 Taxon	% com.	$\bar{x}$/kg
Eohaustorius sp.	33	45	Prionospio sp.	19	28	Prionospio sp.	21	39	Dendraster excentricus	46	94
Nematoda	19	25	Tellina sp.	18	31	Ostracoda	20	36	Ostracoda	18	40
Phoxocephalid	13	18	Ostracoda	8	15	Tellina sp.	11	20	Spionidae	9	21
Ostracoda	6	8	Nephtys sp.	7	12	Phoxocephalid	6	13	Gammaridae	8	20
Prionospio sp.	6	8	Dendraster sp.	6	11	Magelona sp.	5	10	Hiatella arctica	6	14
Tellina sp.	4	5	Magelona sp.	6	9	Nephtys sp.	5	8			
Other Amphipoda	2	3	Pelycepoda	4	5	Dendraster sp.	2	4			

Station 21, 10,500' S. of Moss Landing, 9 fathoms. (54')

June 10, 1966 Taxon	% com.	$\bar{x}$/kg	October 24, 1966 Taxon	% com.	$\bar{x}$/kg	July 1, 1967 Taxon	% com.	$\bar{x}$/kg	July 11, 1968 Taxon	% com.	$\bar{x}$/kg
Eohaustorius sp.	29	48	Ostracod	26	46	Ostracod	18	48	Dendraster excentricus	37	205
Dendraster sp.	10	16	Tellina sp.	20	32	Prionospio sp.	17	36	Ostracoda	22	98
Ostracod	9	15	Eohaustroius sp.	12	21	Eohaustorius sp.	14	35	Spionidae	9	42
Phoxocephalid	9	16	Phoxocephalid	10	17	Tellina sp.	12	28	Hiatella arctica	6	24
Tellina sp.	6	13	Dendraster sp.	8	13	Spisula sp.	9	19	Nematoda	6	22
Other Polychaeta	6	9	Prionospio sp.	5	7	Phoxocephalid	6	15	Gammaridae	6	25
Magelona sp.	6	9	Nephtys sp.	2	4	Nematoda	4	8			
Prionospio sp.	5	9	Other Amphipoda	2	3	Magelona sp.	3	7			

* Source: Chartock, 1969.

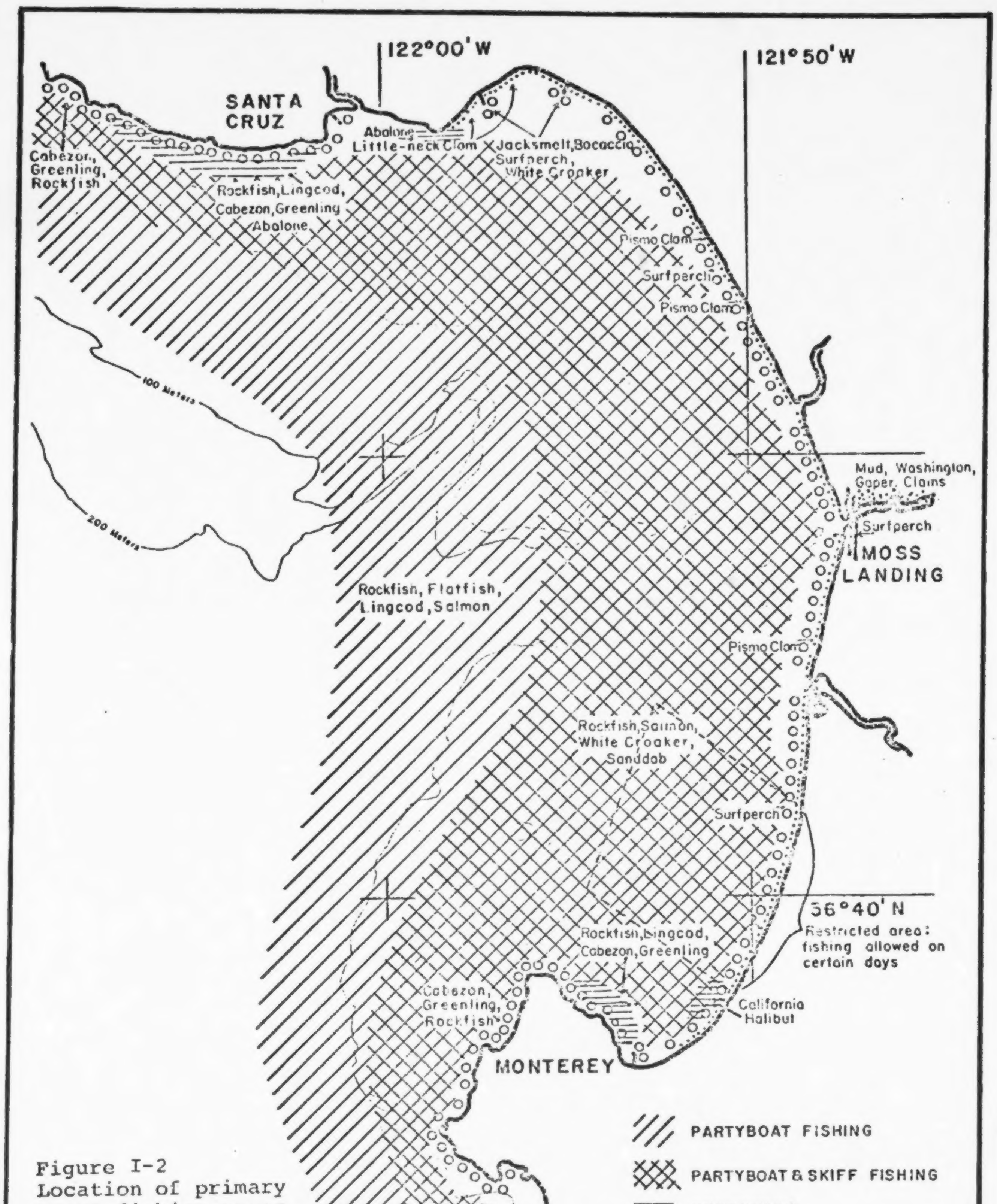
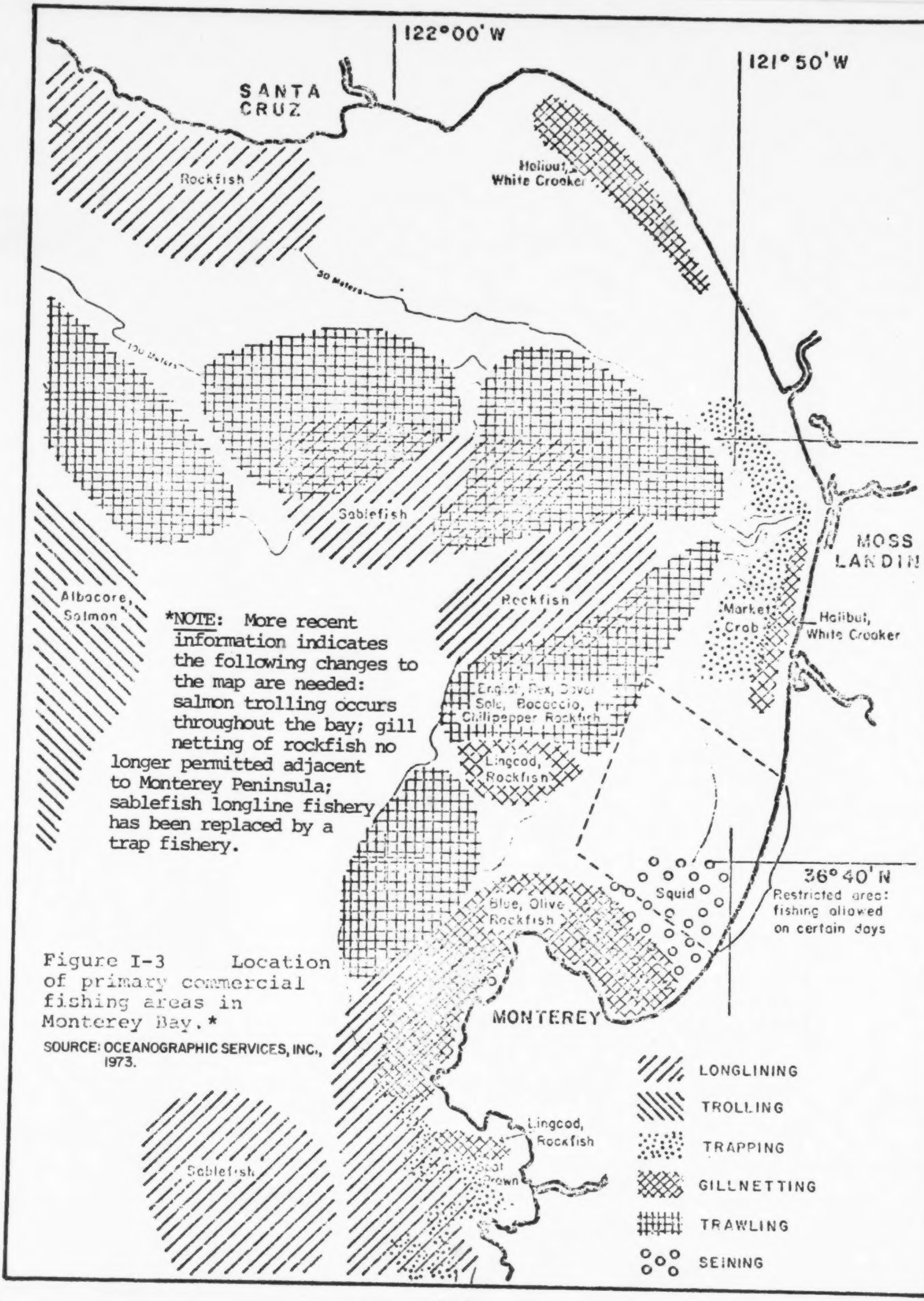

122°00'W
121°50'W
SANTA CRUZ
Cabezon, Greenling, Rockfish
Abalone
Little-neck Clam
Jacksmelt, Bocaccio
Surfperch, White Croaker
Rockfish, Lingcod, Cabezon, Greenling Abalone
Pismo Clam
Surfperch
Pismo Clam
100 Meters
200 Meters
Mud, Washington, Gaper, Clams
Surfperch
MOSS LANDING
Rockfish, Flatfish, Lingcod, Salmon
Pismo Clam
Rockfish, Salmon, White Croaker, Sanddab
Surfperch
36°40'N
Restricted area: fishing allowed on certain days
Rockfish, Lingcod, Cabezon, Greenling
Cabezon, Greenling, Rockfish
California Halibut
MONTEREY
Greenling, Lingcod, Rockfish, Cabezon,
PARTYBOAT FISHING
PARTYBOAT & SKIFF FISHING
SKINDIVING
CLAMMING
PIER & SHORE FISHING

Figure I-2
Location of primary sport fishing areas in Monterey Bay.

SOURCE: OCEANOGRAPHIC SERVICES, INC., 1973



*NOTE: More recent information indicates the following changes to the map are needed: salmon trolling occurs throughout the bay; gill netting of rockfish no longer permitted adjacent to Monterey Peninsula; sablefish longline fishery has been replaced by a trap fishery.

Figure I-3 Location of primary commercial fishing areas in Monterey Bay.*

SOURCE: OCEANOGRAPHIC SERVICES, INC., 1973.

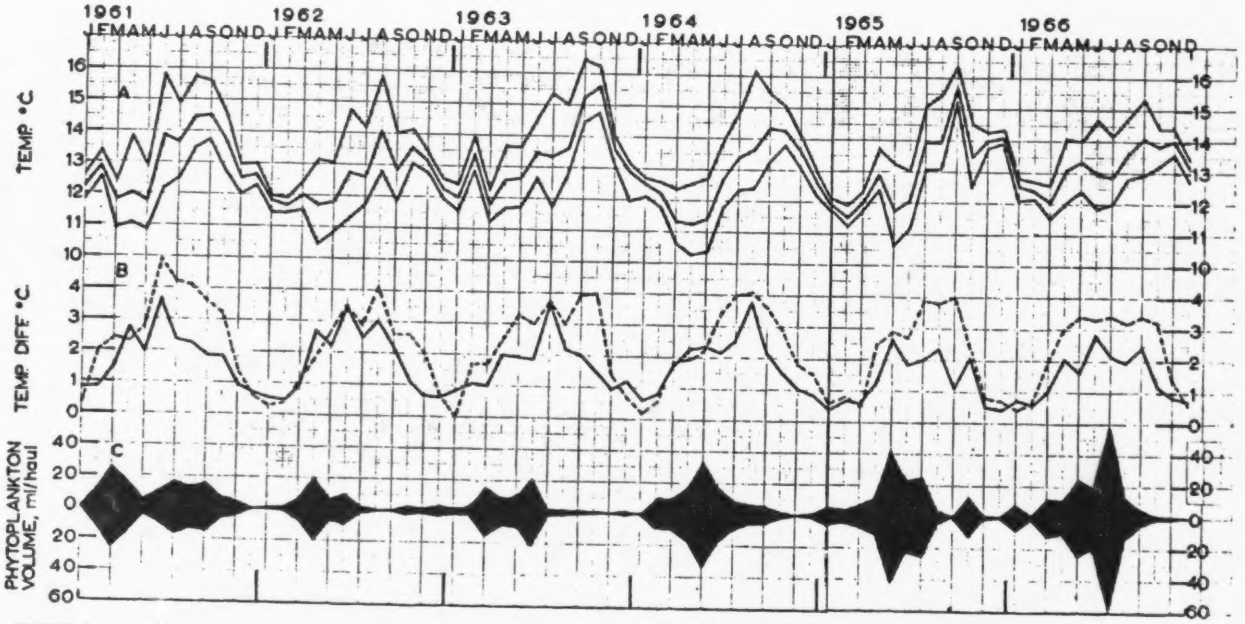


FIGURE 1. Monthly averages of temperature conditions and the volume of the phytoplankton standing crop in Monterey Bay, California, 1961 through 1966. A. Surface temperature (°C), showing monthly means, average monthly maxima, and average monthly minima. B. Solid line—temperature difference (°C) between average monthly maximum and average monthly minimum surface temperatures; broken line—temperature difference (°C) between monthly means of temperatures at the surface and those at 50 meters depth. C. Monthly averages of the volume of the phytoplankton standing crop (ml/haul).

FIGURE I-4 SUMMARY OF THERMAL CONDITIONS AND PHYTOPLANKTON VOLUMES MEASURED IN MONTEREY BAY, CALIFORNIA 1961-1966

SOURCE: ABBOTT & ALBEE, 1967

BACKGROUND DATA -- SOCIO-ECONOMIC ENVIRONMENT

APPENDIX J

POPULATION, EMPLOYMENT, MISCELLANEOUS SOCIO-ECONOMIC DATA

TABLE J-1

Age Characteristics of Population of Study Area Communities, 1960 and 1970

	% under 18		% 65 and Older		Median Age	
	1960	1970	1960	1970	1960	1970
Castroville	44.4	44.2	4.5	5.9	21.0	22.5
Marina	44.5	43.3	2.6	2.3	21.3	22.5
Monterey	33.8	28.7	6.1	8.3	27.0	26.2
Pacific Grove	30.6	24.4	14.5	17.4	33.6	34.4
Salinas	36.2	36.3	6.9	7.5	29.9	26.4
Seaside	43.2	35.1	3.7	2.9	23.2	21.3
County	34.3	32.9	6.2	7.5	24.8	24.2

Source: U.S. Census of Population, General Population Characteristics, California, 1960 (Tables 20, 23-25 and 27) and 1970 (Tables 24,28 and 31).

TABLE J-2

Median Income in Study Area Communities Compared to State, 1960 and 1970

Median Income-Families

	Income		As % of State Median Family Income	
	1960	1970	1960	1970
Castroville	4347	7345	64.6	68.4
Marina	4352	9231	64.7	86.0
Monterey	5884	10250	87.5	95.5
Pacific Grove	5848	9615	86.9	89.6
Salinas	7035	10285	104.6	95.8
Seaside	4572	7421	68.0	69.1
County	5770	9730	85.8	90.7
State	6726	10732	-	-

Source: U.S. Census of Population, General Social and Economic Characteristics, California, 1960 (Tables 36, 65, 76, 81 and 86) and 1970 (Tables 89 and 107)

TABLE J-3

Monterey/Salinas Area Employment by Industry (000's)

	50	52	56	58	60	62	64	66	68	70
Agriculture, forestry and fisheries	1.5*	1.5*	1.5	2.3	2.5	2.2	3.2	3.3	3.3	3.4
Mining	0.1	0.1	0.05	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Contract Construction	2.8	4.2	2.5	2.4	3.0	3.2	4.1	3.7	3.9	3.2
Manufacturing	2.9	4.0	3.6	3.0	4.0	3.9	4.8	5.4	6.0	7.0
Durable goods	0.3	n.a.	0.4	0.6	1.1	0.9	0.9	1.0	1.3	1.5
Nondurable goods	2.6	n.a.	3.2	2.4	2.9	3.0	3.9	4.4	4.7	5.5
Food products	n.a.	n.a.	2.5	1.4	1.8	1.9	2.1	2.1	2.4	3.1
Other nondurable goods	n.a.	n.a.	0.7	1.0	1.1	1.1	1.8	2.3	2.3	2.4
Transportation, communication and utilities	1.6	1.9	2.25	2.2	2.5	3.0	3.2	3.2	3.4	3.3
Wholesale & retail trade	10.55	11.95	11.3	11.6	11.6	13.1	14.3	15.5	16.6	17.6
Finance, insurance and real estate	1.1	1.3	1.6	1.9	1.9	2.1	2.2	2.6	2.6	2.9
Service	6.05	9.4	9.7	10.0	8.7	10.1	11.4	12.1	13.1	15.5
Government	1.6	3.5	4.4	4.8	7.5	9.8	10.7	11.8	14.6	14.8
TOTAL	28.2	37.85	36.9	38.3	41.8	47.5	54.0	57.8	63.6	67.8

*Not reported by the state; assumed based on 1956 figure.

Source: State of California, Dept. of Human Resources Development (formerly Department of Employment), Research & Statistics. Community Labor Market Survey-Salinas & Monterey. Salinas Community Labor Market Area includes Salinas and Salinas South Census Divisions. Monterey Community Labor Market Area includes Monterey, Carmel, Monterey Peninsula, Pacific Grove and Seaside Census Divisions.

Table J-4

CHANGE IN TOTAL EMPLOYMENT FOR VARIOUS INDUSTRY SECTORS -- STUDY AREA COMPARED TO NATION, 1950-1970

	Change in Industry as % of Total Change			
	Includes Gov't. Employees		Excludes Gov't. Employees	
Industry Sector	Region	Nation	Region	Nation
Contract Construction	1.1	3.4	1.6	5.3
Manufacturing-				
Durable goods	3.2	12.1	4.9	16.2
Nondurable goods	7.7	4.1	11.8	5.4
TCU (transportation, communication & utilities)	4.5	1.8	6.9	2.4
Trade	18.7	21.6	28.8	29.1
FIRE (finance, insurance & real estate)	4.8	6.8	7.3	9.2
Service	25.1	24.1	38.6	32.4
Government	35.0	25.5	omitted	omitted

Source: U. S. Department of Commerce, County Business Patterns, 1970; and *Community Labor Market Surveys*, cited in Table 20.

TABLE J-5

Major Crops in Lower Salinas Valley Crop-Acres 1950-1974

Year	Artichokes	Broccoli	Cauliflower	Celery	Lettuce	Strawberries
1950	4,560	6,580	250	1,180	59,517	506
1951	4,945	6,000	300	1,480	55,330	541
1952	5,656	6,350	625	1,597	65,274	1,108
1953	6,015	4,500	680	1,891	60,442	793
1954	5,774	4,650	585	2,580	63,370	1,612
1955	5,800	8,000	1,155	2,740	64,420	2,416
1956	5,373	10,020	2,020	3,624	67,584	5,124
1957	5,662	7,600	1,880	4,350	62,962	6,800
1958	5,631	9,200	2,000	4,150	45,541	4,900
1959	5,802	9,100	2,690	4,621	48,370	4,450
1960	5,515	10,080	3,420	4,825	50,780	3,510
1961	5,480	10,300	3,735	5,040	47,200	3,660
1962	5,500	10,200	4,400	5,070	44,995	3,590
1963	6,260	13,000	5,030	5,600	50,620	3,674
1964	7,410	13,400	5,780	5,040	47,400	3,420
1965	7,440	11,820	5,850	5,070	44,000	2,969
1966	8,817	14,721	4,285	5,265	48,990	2,570
1967	8,575	18,180	6,984	5,260	50,340	2,200
1968	9,323	19,481	7,921	5,685	51,875	1,973
1969	9,900	14,730	8,600	6,209	51,820	2,194
1970	10,240	23,700	8,745	6,240	54,865	2,600
1971	10,530	24,200	9,420	5,775	55,000	2,457
1972	10,720	22,080	10,515	5,600	54,850	1,680
1973	10,480	25,440	9,775	5,910	52,260	1,885
1974	10,300	21,300	9,265	5,275	54,845	2,060

Source: Monterey County Annual Crop Report, 1950-1974.

TABLE J-6

Value of Major Crops in Lower Salinas Valley, 1950-1974 (Thousands of 1975 Dollars*)

YEAR	ARTICHOKES	BROCCOLI	CAULIFLOWER	CELERY	LETTUCE	STRAW-BERRIES	TOTAL
1950	3,901	5,721	181	6,767	55,145	10,492	82,207
1951	3,704	7,370	370	5,771	89,355	8,981	115,551
1952	4,449	7,605	870	7,000	76,033	12,210	108,167
1953	3,402	4,467	683	6,980	89,624	8,293	113,449
1954	3,994	4,621	724	11,184	82,990	15,355	118,868
1955	4,046	7,195	1,479	14,736	83,807	18,479	129,742
1956	4,312	5,727	6,481	9,216	71,487	22,961	120,184
1957	4,619	5,529	2,239	13,347	75,023	19,324	120,079
1958	4,998	6,844	2,252	11,727	45,473	16,637	87,931
1959	6,050	6,663	4,214	21,300	58,896	20,523	117,646
1960	6,614	8,281	5,024	16,352	48,685	31,534	116,490
1961	5,994	8,391	6,366	19,994	54,871	23,099	118,715
1962	6,199	7,626	9,264	16,223	67,836	25,127	132,275
1963	7,733	10,538	6,723	18,886	66,443	30,073	140,396
1964	7,804	9,101	7,841	22,235	89,722	27,994	164,697
1965	8,793	11,188	8,166	24,481	87,918	23,748	164,294
1966	9,382	9,704	21,425	29,894	93,563	21,862	185,830
1967	10,551	14,981	9,470	22,401	107,466	16,237	181,106
1968	9,824	16,478	11,290	21,736	90,983	24,054	174,365
1969	9,403	17,514	13,942	30,237	81,327	19,156	171,579
1970	11,098	21,558	13,118	18,581	99,232	22,643	186,230
1971	12,822	20,526	16,783	30,535	102,014	23,726	206,406
1972	13,153	23,549	17,291	28,476	95,285	21,206	198,960
1973	13,833	25,275	14,655	21,231	154,642	24,894	254,530
1974	14,621	20,523	16,393	22,224	126,815	24,256	224,832

*Conversion to 1975 dollars by Gruen Gruen + Associates based on wholesale price index (WPI). Data on WPI for 1950-1973 from Bureau of Labor Statistics, 1974, Handbook of Labor Statistics and for 1974-75 from Wall Street Journal, Sept. 22, 1975.

Source: Monterey County Annual Crop Report, 1950-1974.

Table J-7

PRIVATE WASTE TREATMENT FACILITIES

Facility	Location	Design Capacity	Major Process Units
Oak Hills Subdivision	Hwy. 156, near Castroville	150,000	Comminutor Percolation Ponds
Monte Del Laguna Mobile Home Park	Castroville Blvd., near Castroville	116,000	Comminutor Aerated Ponds
Salinas	Services Toro Park Estates, Creekside, Toro Creek and Serra Village along Monterey Salinas Hwy.	270,000	Aerated Ponds Chlorination
Indian Springs Ranch Subdivision	River Road, Salinas	90,000	Package Aeration Plant Percolation Ponds Chlorination
Firestone Tire and Rubber Co.	340 El Camino Real South Salinas	50,000 (sanitary) 150,000 (industrial)	Package Aeration Plant Percolation Ponds

Source: Engineering Science, Inc., 1975.

Table J-8

COMMUNITY AND COMMON SEPTIC TANKS WITHIN THE STUDY AREA

1. Kubisch Mobile Home Park - 800 Dolan Road, Castroville. Design capacity - 50 mobile homes (1 system), 12,500 gallon tank + 6,250 square feet drainfield.

2. Moss Landing Mobile Manor - Struve Road, Moss Landing. Design capacity - 105 mobile homes (2 systems).

3. Cabana Holiday - Highway 101 North, Salinas. Design capacity - 103 units on 6 systems.

    a. Two 7,000 gallon tanks + 20 sumps (40'-60') with distribution box (5 per) servicing 48 mobile homes and 16 travel trailers.

    b. 9,000 gallon tank + 20 sumps (40'-60') with distribution box (5 per) servicing 12 motel units and 9 travel trailers.

    c. 8,000 gallon tank + 5 sumps and 2 drainfields with distribution box (equal flow) servicing 8 motel units and 9 travel trailers.

    d. 2,500 gallon tank + hooked into sumps for (b) for 16 travel trailers.

    e. 2,000 gallon tank and unknown drainage for office and clubhouse.

4. Laguna Seca Estates - Monterey-Salinas Highway. Design capacity - 45 units (26 developed) on 1 system (3-7,500 increments) 22,500 gallon septic tank + 45 sumps + repairs. This is a county service area.

5. Monterey Dunes Colony - Molera Road, Moss Landing. Design capacity - 120 units on 8 systems. 12 to 16 units per 6,000 gallon tank + 1,800-2,500 square feet of drainage.

Source: Engineering Science, Inc., 1975.

Table J-9

ZONING SUMMARY CHART

CLASIFICATION	ZONE	USES ALLOWEU (PARTIAL LIST)	MAX HGHT	MIN. REQ'D YDS. FRONT	SIDE	REAR	MIN. AREA	MIN WIDTH	LOT COV.	EAGLE PRISMACOLOR PENCIL CHART
				UNLESS COMBINED WITH 'B' DISTRICT						
AGRICULTURE	F	AGRICULTURAL AGRICULTURAL USES ONE FAMILY DWELLING WITH USE PERMIT LABOR CAMP ANIMAL HOSPITAL CATTLE FEED LOT ANIMAL SALES YARD	35'	30'	10% AVE. LOT WIDTH	20'	2 1/2 ac.	100'	35%	909 GRASS GREEN
	K	AGRICULTURAL - RESIDENTIAL SAME AS 'F' DISTRICT	35'	20'	6'	20'	10,000*	60'	35%	910 EMERALD GREEN
	AP	AGRICULTURAL - PRESERVE SAME AS 'F' DISTRICT	35'	30'	20'	20'	40 ac.	NONE	NONE	942 YELLOW OCHRE
	N	RURAL SAME AS 'F' DISTRICT	35'	60'℄	10'	10'	20,000*	100'	NONE	912 APPLE GREEN
	T	TRANSITIONAL SAME AS 'F' DISTRICT	35'	20'	6'	20'	10.000*	60'	35%	904 LIGHT BLUE
RESIDENTIAL	R-1	ONE FAMILY RES. ONE FAMILY DWELLING WITH USE PERMIT COUNTRY CLUB PUBLIC & QUASI PUBLIC USES	30'	20'	6'	10'	6.000*	60'	35%	915 LEMON YELLOW
	R-2	DUPLEX RES. ONE FAMILY DWELLING DUPLEX WITH USE PERMIT USES ALLOWED IN 'R-1' DISTRICT HOSPITAL RESTHOME	30'	20'	6'	10'	6,000*	60'	40%	917 YELLOW ORANGE
	R-3	LIMITED MULTI. FAMILY RES. ONE FAMILY DWELLING DUPLEX WITH USE PERMIT USES ALLOWED IN 'R-2' DISTRICT RESORT HOTEL PROFESSIONAL OFFICE	45'	20'	5'	10'	6000*	60'	60%	937 FLESH
	R-4	MULTI. FAMILY RES. ONE FAMILY DWELLING DUPLEX MULTIPLE DWELLING DWELLING GROUP WITH USE PERMIT USES ALLOWED IN 'R-3' DISTRICT HOTEL MOBILE HOME PARK	35'	20'	5'	10'	6000*	60'	60%	918 ORANGE
	*	THIS LIST IS A SUMMARY OF ZONING DISTRICTS AS DESCRIBED IN THE ZONING ORDINANCE AND IS NOT PART OF THE ZONING ORDINANCE. FOR COMPLETE INFORMATION REFER TO THE ZONING ORDINANCE.								

Source: Monterey County Planning Department, pers. comm.

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ZONING SUMMARY CHART

CLASSIFICATION	ZONE	USES ALLOWED (PARTIAL LIST)	MAX. HGHT.	MIN. REQ'D YDS.			MIN. AREA	MIN. WIDTH	LOT COV.	EAGLE PRISMACOLOR PENCIL CHART
				FRONT	SIDE	REAR				
				UNLESS COMBINED WITH "B" DISTRICT						
RESIDENTIAL	ST	SPECIAL TREATMENT ONE FAMILY DWELLING WITH USE PERMIT MULTIPLE RESIDENCES TO DESIGNATED DENSITY	AS APP.	AS APP.	10'	10'	5 AC.	AS APP	AS DETERM. BY DESIGN	941 RAW UMBER
	SC	SCENIC CONSERVATION ONE FAMILY DWELLING AGRICULTURAL USES WITH USE PERMIT COUNTRY CLUB DUPLEX MULTIPLE DWELLING DWELLING GROUP HOTEL AUTOMOBILE COURT	20'	100'	10'	20'	AS SHOWN ON SECTION	100'	NONE	907 PEACOCK GREEN
COMMERCIAL	C-1	RETAIL BUSINESS RETAIL BUSINESS WITH USE PERMIT DWELLING USES SERVICE STATION DRIVE IN RESTAURANT ADVERTISING SIGNS	35'	NONE	NONE	5' W/ ALLEY — 15' W/O ALLEY	2000*	25'	NONE	924 CRIMSON
	H-1	HIGHWAY FRONTAGE ONE FAMILY DWELLING WITH USE PERMIT DUPLEX MULTIPLE DWELLING AUTOMOBILE COURT SERVICE STATION RESTAURANT	35'	30'	6'	20'	6000*	60'	40%	944 TERRA COTTA
	PC	PLANNED COMMERCIAL W/ GEN. DEVELOPMENT PLAN & ZONING PERMIT RETAIL STORES SERVICE STATION HOTEL PUBLIC & QUASI PUBLIC USES	AS APP.	AS APP.	AS APP.	AS APP.	AS APP.	AS APP.	25%	905 AQUA-MARINE
	C-2	GENERAL COMMERCIAL RETAIL BUSINESS SERVICE STATION WITH USE PERMIT DWELLING USES CONTRACTORS YARD WELDING SHOP ADVERTISING SIGNS	45'	NONE	NONE	5' W/ ALLEY — 15' W/O ALLEY	2000*	25'	NONE	967 LIGHT GREY

* THIS LIST IS A SUMMARY OF ZONING DISTRICTS AS DESCRIBED IN THE ZONING ORDINANCE AND IS NOT PART OF THE ZONING ORDINANCE. FOR COMPLETE INFORMATION REFER TO THE ZONING ORDINANCE.

ZONING SUMMARY CHART

CLASSIFICATION	ZONE	USES ALLOWED (PARTIAL LIST)	MAX. HGHT.	MIN. REQ'D. YDS.			MIN. AREA	MIN. WIDTH	LOT COV.	EAGLE PRISMACOLOR PENCIL CHART
				FRONT	SIDE	REAR				
				UNLESS COMBINED WITH 'B' DISTRICT						
COMMERCIAL	CR	COMMERCIAL RECREATION BOAT RENTALS SALE OF MARINE SUPPLYS DOCK, PIER, MARINA WITH USE PERMIT MARINE SERVICE ESTABLISHMENT RESTAURANT MOTEL TRAILER CAMP	35'	NONE	NONE	NONE	6,000*	60'	NONE	929 PINK
INDUSTRIAL	LM	LIMITED INDUSTRIAL MANUFACTURE OF CLOTHING PRINTING SHOP PROFESSIONAL OFFICE RESEARCH LABRATORY WITH USE PERMIT RESIDENTIAL USES FURNITURE MANU.	35'	50'	10% LOT WIDTH	50'	1 ACRE	NONE	25%	932 VIOLET
	M	INDUSTRIAL RETAIL BUSINESS SERVICE STATION WITH USE PERMIT RESIDENTIAL USES WRECKING YARD MANU OF ACID SMELTING OF ORES ADVERTISING SIGNS	75'	10% LOT DEPTH	10% LOT WIDTH	10% LOT DEPTH	10,000*	100'	50%	901 INDIGO
COMBINING	A	LIMITED AGRICULTURE ANIMAL HUSBANDRY SMALL LIVESTOCK FARMING WITH USE PERMIT DOG & CAT KENNEL RIDING ACADEMY		ACCESSORY BUILDINGS 50'	20'	20'				
	S	INTEGRATED ALL USES PERMITTED IN RESPECTIVE DISTRICTS WITH WHICH IT'S COMBINED WITH USE PERMIT DUPLEX MULTIPLE DWELLING DWELLING GROUPS								
	P	PARKING ESTABLISHES PARKING REGULATIONS FOR MOST USES								
	*	THIS LIST IS A SUMMARY OF ZONING DISTRICTS AS DESCRIBED IN THE ZONING ORDINANCE AND IS NOT A PART OF THE ZONING ORDINANCE. FOR COMPLETE INFORMATION REFER TO THE ZONING ORDINANCE.								

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ZONING SUMMARY CHART

CLASIFICATION	ZONE	USES ALLOWED (PARTIAL LIST)	MAX. HGHT.	MIN. REQ'D. YDS.			MIN. AREA	MIN. WIDTH	LOT COV.	EAGLE PRISMACOLOR PENCIL CHART
				FRONT	SIDE	REAR				
				UNLESS COMBINED WITH A 'B' DISTRICT						
COMBINING	B	BUILDING SITE WHEN COMBINED WITH ANY DISTRICT SETS UP THE BUILDING REQUIREMENTS								
		B-1		25'	10% AVERAGE LOT WIDTH	10'	8000#			
		B-2		25'		10'	10000#			
		B-3		30'		15'	20000#			
		B-4		30'		20'	1 ACRE			
		B-5		AS SHOWN ON SECTIONAL DISTRICT MAPS BUT NOT LESS THAN B-4						
		B-6		AS SHOWN ON FINAL SUBDIVISION MAPS BUT NOT LESS THAN B-4						
	G	RURAL PROFESSIONAL ALL USES PERMITTED IN RESPECTIVE DISTRICT WITH WHICH THIS DISTRICT IS COMBINED WITH USE PERMIT								
		RESORT HOTEL					10 ACRE			
		HOSPITAL					10 ACRE			
		EXECUTIVE OFFICES					5 ACRE			
		RESEARCH LABORATORY					10 ACRE			
	X	CAMP WITH USE PERMIT CAMP GROUND TENT CAMP TRAILER CAMP TROUT FARM MOBILE HOME PARK								
	E	FRONTAGE EXEMPTION LOTS 2 1/2 ACRES OR GREATER ARE EXEMPT FROM FRONTAGE REQUIREMENT								
	FP	FLOOD PLAIN WITH USE PERMIT USES ALLOWED IN DISTRICT WITH WHICH DISTRICT IS COMBINED PRIVATE & PUBLIC RECREATIONAL USES								
	P	PARKING ESTABLISHES PARKING FOR MOST USES								
	D	DESIGN CONTROL REQUIRES APPROVAL OF DESIGN AND COLOR OF BUILDINGS AND STRUCTURES								
	O	OPEN SPACE DESIGNED TO HOLD FOR FUTURE GENERATIONS OPEN SPACE IN WHICH TREES AND PLANTS MAY GROW									911 OLIVE GREEN
	*	THIS LIST IS A SUMMARY OF ZONING DISTRICTS AS DESCRIBED IN THE ZONING ORDINANCE AND IS NOT PART OF THE ZONING ORDINANCE. FOR COMPLETE INFORMATION REFER TO THE ZONING ORDINANCE.								

ZONING SUMMARY CHART

CLASSIFICATION	ZONE	USES ALLOWED (PARTIAL LIST)	MAX. HGHT.	MIN. REQ'D YDS. FRONT	SIDE	REAR	MIN AREA	MIN WIDTH	LOT COV.	EAGLE PRISMACOLOR PENCIL CHART
				UNLESS COMBINED WITH 'B' DISTRICT						
COMBINING	Y	AIRPORT AIRPORTS WITH USE PERMIT ACCESSORY USES TO AIRPORT								931 PURPLE
	L	MOBILE HOME WITH USE PERMIT MOBILE HOMES								
	J	TRAILER EXCLUSION NO MOBILE HOMES AS LIVING UNITS								
	Z	IMPROVEMENT DEDICATE O.P.L. AREA INSTALL SIDEWALK, CURB, GUTTER, EXTEND PAVEMENT								
	U	UNCLASSIFIED ALL USES EXCEPT THOSE REQUIRING A USE PERMIT WITH USE PERMIT LABOR CAMPS JUNK YARD ASSEMBLY OF PEOPLE MOBILE HOME PARK					2 1/2ac			

* THIS LIST IS A SUMMARY OF ZONING DISTRICTS AS DESCRIBED IN THE ZONING ORDINANCE AND IS NOT PART OF THE ZONING ORDINANCE. FOR COMPLETE INFORMATION REFER TO THE ZONING ORDINANCE.

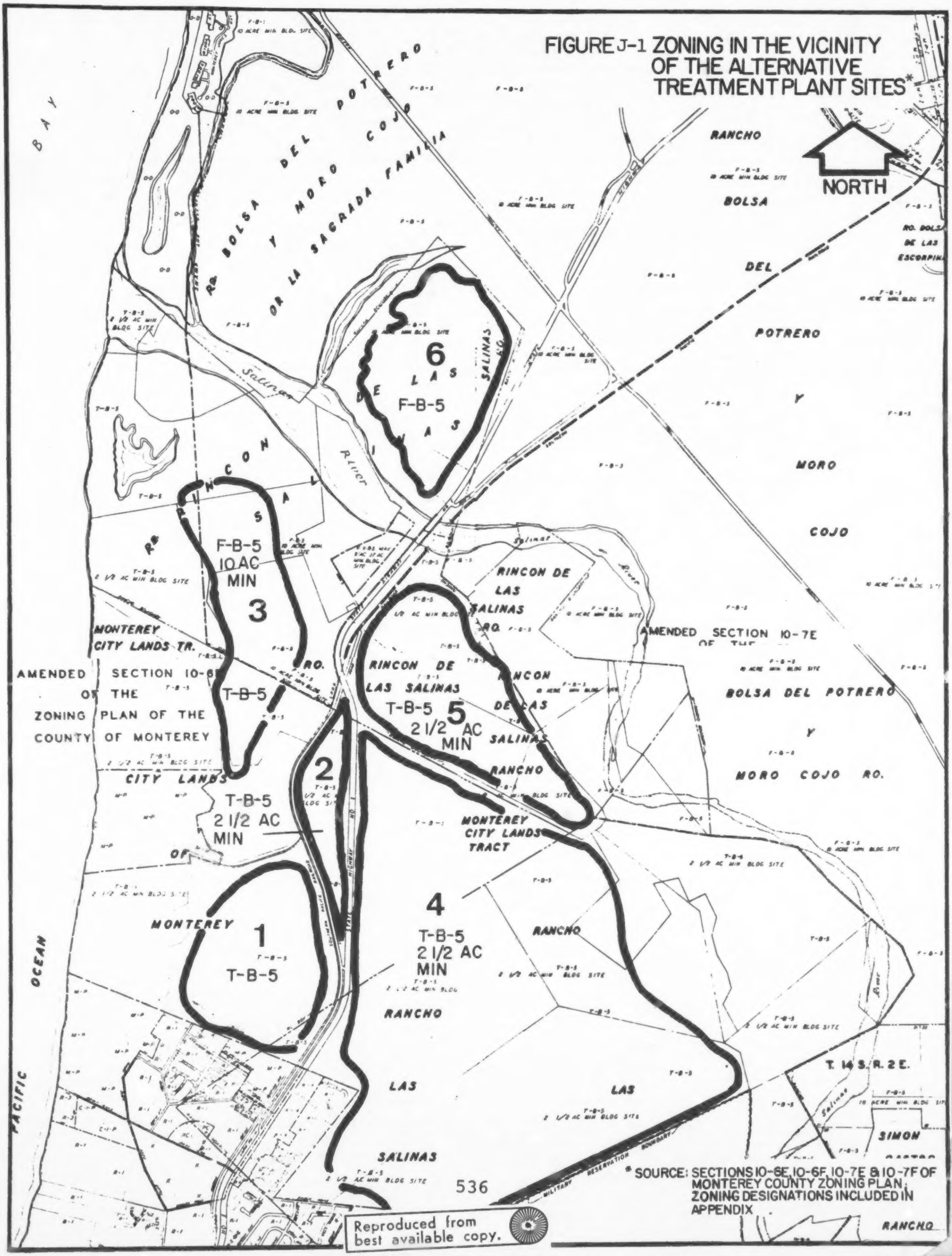
NORTH
BAY
PACIFIC OCEAN
RO. BOLSA DEL POTRERO Y MORO COJO OR LA SAGRADA FAMILIA
RANCHO BOLSA DEL POTRERO Y MORO COJO
RO. BOLSA DE LAS ESCORPINAS
BOLSA DEL POTRERO Y MORO COJO RO.
RO. RINCON DE LAS SALINAS
RINCON DE LAS SALINAS RO.
RANCHO LAS SALINAS
MONTEREY CITY LANDS TRACT
MONTEREY CITY LANDS TR.
Salinas River
AMENDED SECTION 10-6F OF THE ZONING PLAN OF THE COUNTY OF MONTEREY
AMENDED SECTION 10-7E OF THE
T. 14 S. R. 2 E.
MILITARY RESERVATION BOUNDARY
1
T-B-5
2
T-B-5
2 1/2 AC
MIN
3
F-B-5
10 AC
MIN
T-B-5
4
T-B-5
2 1/2 AC
MIN
5
T-B-5
2 1/2 AC
MIN
6
F-B-5
F-B-5
10 ACRE MIN BLDG SITE
T-B-5
2 1/2 AC MIN BLDG SITE

FIGURE J-1 ZONING IN THE VICINITY OF THE ALTERNATIVE TREATMENT PLANT SITES*

* SOURCE: SECTIONS 10-6E, 10-6F, 10-7E & 10-7F OF MONTEREY COUNTY ZONING PLAN. ZONING DESIGNATIONS INCLUDED IN APPENDIX

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Table J-10

MILES OF ROADS AND DAILY VEHICLE MILES OF TRAVEL

Jurisdiction	MILES OF ROADS/STREETS 1972	1973	% Change	VEHICLE MILES OF TRAVEL PER DAY 1972	1973	% Change
Carmel	27.70	27.70	0.0	33,000	34,000	+3.0
Del Rey Oaks	5.62	5.90	+5.0	1,700	1,700	0.0
Monterey	108.67	108.67	0.0	434,500	456,464	+5.1
Pacific Grove	48.08	54.80	+14.0	54,700	76,092	+39.1
Sand City	4.09	4.09	0.0	614	614	0.0
Seaside	65.50	65.63	+0.2	114,100	117,028	+2.5
Subtotal, Study Area Cities	259.66	266.79	+2.7	638,614	685,898	+7.4
Salinas	160.32	160.94	+0.4	518,234	572,754	+15.3
Gonzales	9.00	9.00	0.0		7,200	
Soledad	11.05	11.05	0.0		10,000	
Greenfield	9.73	9.73	0.0		6,100	
King City	15.13	15.13	0.0		22,750	
Monterey County Unincorporated	1,335.80	1,329.56	-0.5	621,400*	1,292,112	
CALTRANS	300.79	300.77	0.0	1,635,500*	2,868,835	
TOTAL	2,101.48	2,102.97	+0.1	3,392,514*	5,465,649	

* Salinas-Monterey Area Transportation Study area only.

Source: Alan M. Voorhees & Associates, Inc., 1975.

Table J-11*

TYPICAL CONSTRUCTION EQUIPMENT FUEL CONSUMPTION RATES

Diesel	Diesel gal/hr	Gasoline gal/hr
Tracklaying tractor	4.38	
Wheeled tractor	2.91	2.97
Wheeled dozer	11.30	
Scraper	14.83	
Motor grader	3.10	3.11
Wheeled loader	5.97	4.28
Tracklaying loader	2.42	
Off-highway track	14.57	
Roller	2.22	3.47
Miscellaneous	4.52	4.31

* Calculated from exhaust hydrocarbon emission factors given in U. S. Environmental Protection Agency, 1976.

PROJECT ENGINEERING PROPOSALS

APPENDIX K

PROPOSED TREATMENT PROCESSES AND LEVELS

DESCRIPTION OF PROPOSED TREATMENT PROCESSES AND EFFLUENT QUALITY

In the interest of clarity and brevity, the text discussion of the five selected alternatives did not provide a description of the processes to be utilized nor the anticipated effluent quality. This appendix is included to provide this information. Should the reader desire additional information, he is referred to the companion document to this EIS, Facilities Plan for North Monterey County, prepared by Engineering Science, Inc. (ESI) for the Monterey Peninsula Water Pollution Control Agency.

In the text of the EIS, mention is made of various levels of treatment. These levels, developed by ESI and not identical to RWQCB levels, are defined as follows:

Level I-A:	Biological treatment plus limited disinfection.
Level I-B:	Biological treatment plus extensive disinfection.
Level II:	Level I-B plus filtration.
Level III:	Level I-B plus filtration and nitrification.
Level IV:	Level I-B plus chemical coagulation, settling and filtration.
Level V:	Level I-B plus nitrification, denitrification, chemical coagulation, settling and filtration.

Table K-1 shows the effluent quality each process would be expected to produce while Table K-2 lists the quality of existing wastewater discharges.

In the following section, the treatment levels are described and then the project alternatives are described in terms of the process flow which has been recommended by ESI.

Table K-1

TREATMENT PROCESSES AND EFFLUENT QUALITY

Reproduced from best available copy.

Treatment level	Process description	Disposal mode	Effluent quality							
					Bacteriological		Toxicants		Biostimulants	
			Suspended solids, mg/1	BOD$_5$, mg/1	Total coliform, MPN/100 ml	Fecal coliform, no./100 ml	Ammonia[a], mg/1	Toxicity, t.u.	Total nitrogen, mg/1	Total phosphorus, mg/1
IA	Sedimentation, carbonaceous oxidation, disinfection	Ocean disposal	30	30	1,000	200	25	0.8	45	8
IB	Sedimentation, carbonaceous oxidation, disinfection	Salinas River during winter **infiltration/ percolation**	30	30	23		25	0.8	45	8
II	Sedimentation, carbonaceous oxidation, filtration, disinfection	Infiltration/ percolation	5	15	2.2		25	0.8	30	6
III	Sedimentation, carbonaceous oxidation, nitrification, filtration, disinfection	**Salinas River during summer - Stage 1**	5	10	2.2		0.5	0.6	30	6
IV	Sedimentation, carbonaceous oxidation, chemical coagulation, sedimentation, filtration, disinfection	Reuse: Spray irrigation of food crops	2	5	2.2		20	0.6	30	1.5
V	Sedimentation, carbonaceous oxidation, nitrification, nutrient removal, chemical coagulation, sedimentation, filtration, disinfection	Salinas River discharge during summer **Stage 2**	2	5	2.2		0.5	0.1	5	0.5

[a] Ammonia expressed as nitrogen

Source: Engineering Science, Inc., 1976b.

Table K-2

TYPICAL CONCENTRATIONS OF CHEMICAL CONSTITUENTS IN WASTEWATER EFFLUENTS, MG/L

Constituent	Salinas No. 1	Monterey	Fort Ord	Pacific Grove	Seaside	Marina	Salinas No. 2	Castroville	Flow, weighted avg
Major anions									
Bicarbonate	179	78	131	170	320	--	147	302	164
Chloride	290	182	162	136	365	285	143	175	231
Sulfate	142	98	100	70	110	75	78	49	109
Nitrate as NO_3	26.6	2.2	0.4	6	1.6	--	44.3	0.75	12.9
Phosphate as PO_4	--	34	25.6	33	28.2	--	--	40	30.8
Major cations									
Sodium	178	150	88	74.6	215	178	72	141	146
Potassium	10.4	13.2	8.4	20	22.5	13	7.0	16.8	12.8
Calcium	15.0	44.6	96	34.5	65.5	53	49	102	45.0
Magnesium	28.0	21.0	23.9	14.0	22.0	22	32	13.8	23.6
Other data									
Total nitrogen	37.1	39	17.2	--	44.0	--	28.9	--	34.3
Boron	0.7	--	0.41	0.6	0.5	0.4	0.1	1.2	0.57
Hardness	296	200	--	150	299	--	22.4	204	248
TDS/EC[a]	953/1,490	666/1,040	696/1,088	493/771	1,024/1,600	813/1,270	444/694	711/1,111	783/1,223
Cadmium	<0.001	0.004	0.003	<0.001	<0.001	<0.001	--	--	<0.001
Chromium	<0.05	<0.01	0.015	0.02	<0.02	<0.02	--	0.02	<0.03
Copper	0.36	0.20	0.05	0.27	0.09	0.08	0.02	0.025	0.21
Lead	0.029	0.04	0.23	0.006	0.016	<0.005	--	0.3	0.06
Nickel	0.06	<0.01	0.02	<0.05	<0.05	<0.05	--	--	<0.06
Zinc	0.49	0.37	0.30	0.29	0.11	0.07	--	0.16	0.35
Iron	1.03	0.64	0.25	0.53	2.13	0.44	0.1	0.2	0.80
Fluoride	1.0	0.40	1.6	0.2	--	1.6	0.05	0.8	0.86
Manganese	0.5	0.01	0.03	--	<0.05	0.01	0.1	--	0.21

a. EC = electrical conductivity in micromhos/cm.

Source: Metcalf & Eddy, 1975.

Proposed Treatment Levels

Level I-A

This proposed treatment process is commonly known as biological (or secondary) treatment and disinfection. There are several different biological treatment processes in common use, but this specific level of treatment assumes that the activated sludge process is utilized. The disinfection mode proposed by ESI is low dosage chlorination. (Alternative biological treatment and disinfection processes are discussed in the Alternatives section.) The process sequence is as follows: primary sedimentation, *carbonaceous oxidation* and disinfection (see Glossary for definition of terms). Effluent produced by this treatment process is of sufficient quality for ocean disposal through a deep outfall.

The level of total coliform organisms in this effluent (Table K-1) is relatively high because a low level of disinfection is utilized. This disinfection method is practiced because waste discharge requirements for deep ocean outfalls allow relatively large total coliform counts.

Level I-B

The level of I-B treatment process is essentially the same as I-A except a higher chlorine dosage is proposed in order to reduce the number of bacterial organisms remaining in the water. Wastewater treated to this level is also of sufficient quality to be discharged to the ocean.

Level II

The proposed Level II process includes biological (activated sludge) treatment, filtration and chlorine disinfection. The filtration is added to reduce suspended solids and biochemical oxygen demand in the effluent that would otherwise slow the infiltration/percolation disposal process proposed to follow Level II treatment. Filtration also slightly reduces the total nitrogen and phosphorous content of the effluent.

Level III

Level III treatment would add a nitrification step to the Level II process. The process sequence would therefore be as follows: primary sedimentation, carbonaceous oxidation, nitrification, filtration and disinfection. Nitrification is a biological process whereby ammonia is oxidized into nitrite and then nitrate by different groups of microorganisms. This is desirable in that unstable ammonia creates a relatively high biochemical oxygen demand in receiving waters and is toxic to fish in relatively low doses. Nitrate on the other hand is stable.

Nitrification can be achieved by increasing the water retention time in an activated sludge system and thoroughly aerating waste stream.

This treatment level is proposed for effluent discharge to the lower Salinas River, primarily when there are high natural flows in the river. Its use on a year-round basis is analyzed in the Impacts section of the EIS.

Level IV

Level IV is the conventional biological treatment system followed by a relatively high level of tertiary treatment. The primary sedimentation and carbonaceous oxidation of treatment Level I-B is followed by addition of a chemical coagulant (probably lime or alum) to reduce the suspended solids and BOD load of the wastewater. The coagulation is followed by secondary sedimentation, filtration and finally disinfection. In addition to reducing suspended solids and BOD, the total phosphorous content of the water is lowered.

This treatment level was designed by ESI to meet the public health requirements for wastewater reuse on food crops. The wastewater quality would be sufficient to allow either furrow or spray irrigation. No nitrification step is proposed because the wastewater would not be discharged to surface waters; therefore, ammonia toxicity would not be a problem.

Level V

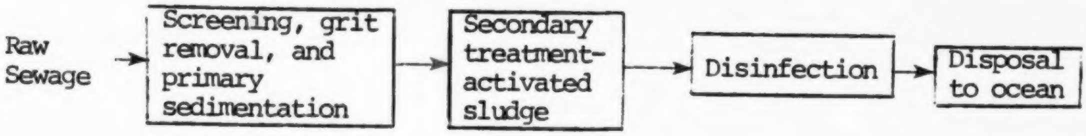
Treatment Level V is an advanced tertiary treatment system designed to reduce effluent toxicity and nutrients to the lowest levels possible. This will allow the wastewater to be discharged to surface waters at any time of the year. Biological treatment is followed by both nitrification and denitrification-chemical coagulation, secondary sedimentation, filtration and disinfection.

The nitrification step which follows the normal activated sludge treatment would be accomplished as described for Level III. This would be followed by denitrification which is simply the conversion of nitrate nitrogen to nitrogen gas. This is accomplished by adding a carbon source and subjecting the wastewater to anaerobic conditions where certain microorganisms utilize the carbon source in conversion of the nitrates. After the water is denitrified, a chemical coagulant is added to reduce suspended solids and phosphorous content; it is then settled, filtered and disinfected prior to disposal.

Alternative Project Treatment System Flow Charts

Alternative 1

Alternative 1 utilizes treatment Level I-A year-round for discharge to the ocean. This is sufficient treatment to meet state and federal requirements and reduce total coliform counts to acceptable levels. The process flow is diagrammed below.

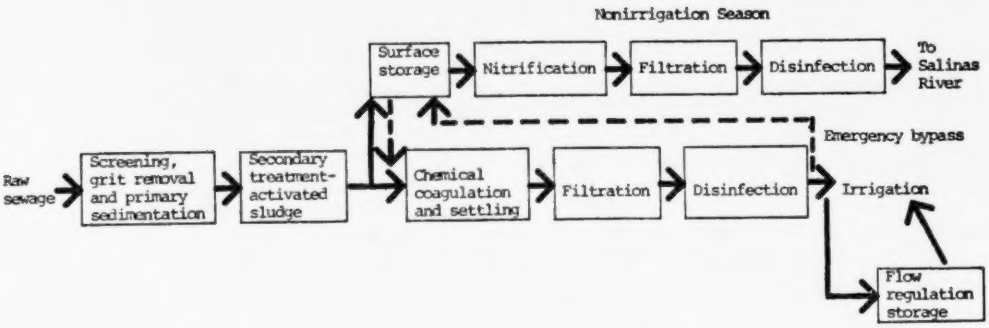

Raw Sewage
Screening, grit removal, and primary sedimentation
Secondary treatment-activated sludge
Disinfection
Disposal to ocean

Alternative 134

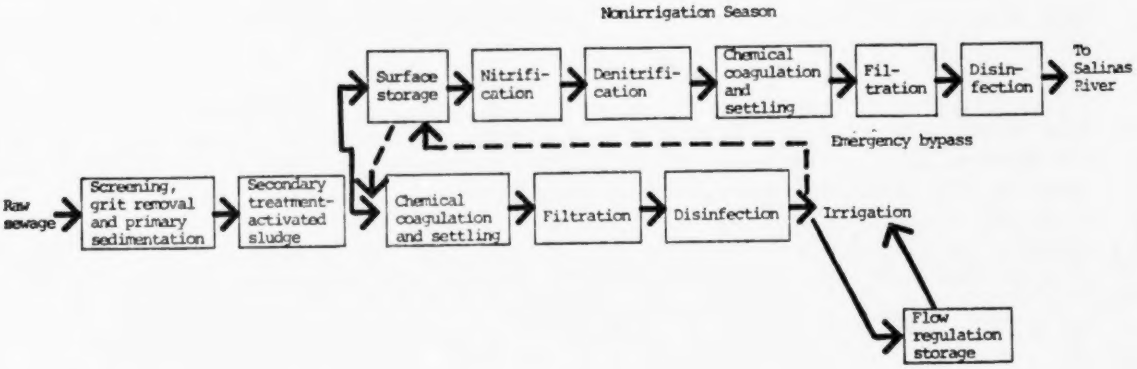
Several different treatment levels have been considered for use in Alternative 134. This combined irrigation reuse-lower Salinas River discharge option must satisfy both State Department of Health and RWQCB water quality standards for crop irrigation and surface water discharge. Effluent used for irrigation from April to October or November must be treated to Level IV. Treatment Level IV is required for crop irrigation because State Department of Health regulations (see Appendix L) specify spray-irrigated effluent, if used on food crops, must be "adequately disinfected, oxidized, coagulated, clarified, filtered wastewater" (Title 22, Section 60303 of the California Administrative Code). This reduces bacterial levels, suspended solids and turbidity to acceptable levels.

During the nonirrigation season or at times when irrigation demand is low and effluent must be discharged to the Salinas River, the treatment level would be III or V. The question of which level is appropriate and under what stream flow conditions is analyzed in part in this EIS (see Water Quality Impacts section). The two possible process flow diagrams are presented below.

Levels IV and III

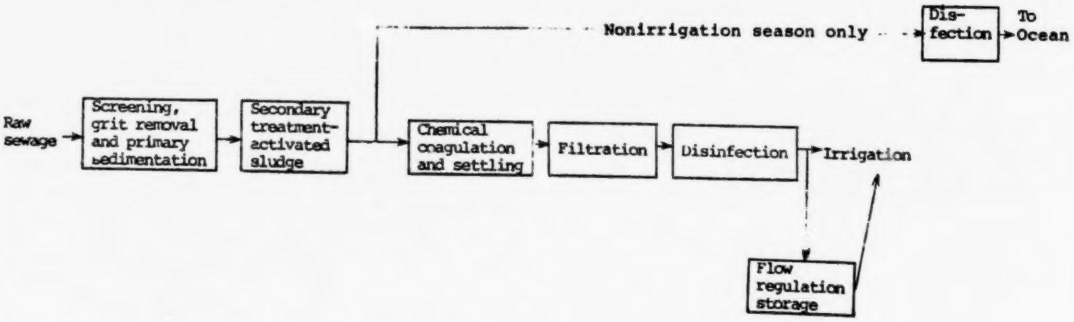


Levels IV and V



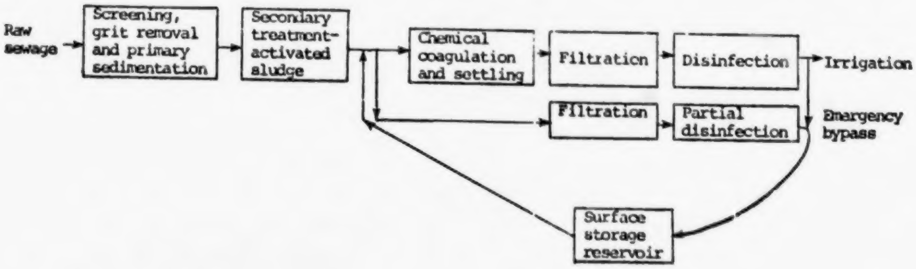
Alternative 166

This is the alternative recommended in the facilities plan. It includes use of treatment Level I-B for ocean disposal through a deep outfall during the nonirrigation season and use of Level IV for effluent destined for crop irrigation, usually from April to October.


Nonirrigation season only
Dis-fection
To Ocean
Raw sewage
Screening, grit removal and primary sedimentation
Secondary treatment-activated sludge
Chemical coagulation and settling
Filtration
Disinfection
Irrigation
Flow regulation storage

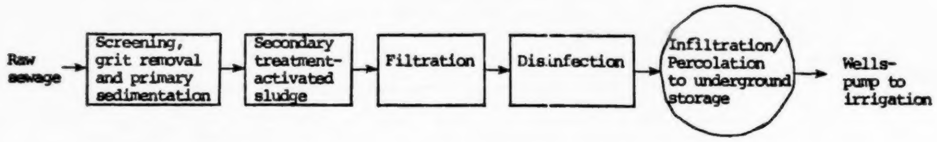
Alternative 170

Alternative 170 includes surface storage of wastewater as an interim step in the treatment process and would therefore involve several different stages of treatment. All wastewater would be treated to Level II prior to surface storage and then pumped back to the plant for Level IV treatment prior to irrigation reuse. The Level II treatment prior to storage is necessary to reduce public health and sediment build-up problems at the reservoir site. Reasons for using Level IV treatment prior to irrigation are discussed under Alternative 134. The Alternative 170 process flow diagram is presented below.


Raw sewage
Screening, grit removal and primary sedimentation
Secondary treatment-activated sludge
Chemical coagulation and settling
Filtration
Disinfection
Irrigation
Filtration
Partial disinfection
Emergency bypass
Surface storage reservoir

Alternative 171

Alternative 171 also involves intermediate storage of wastewater, but the storage is subsurface. The sandy soils of the proposed storage site are considered sufficient to provide an advanced level of treatment simply by percolating the wastewater to the subsurface. Therefore, only Level II treatment would be necessary prior to applying the wastewater to percolation/infiltration ponds. No additional treatment would be required after pumping up from underground storage; delivery would be made directly to the irrigation area. The process flow diagram is presented below.


Raw sewage
Screening, grit removal and primary sedimentation
Secondary treatment-activated sludge
Filtration
Disinfection
Infiltration/ Percolation to underground storage
Wells-pump to irrigation

APPENDIX L

PROPOSED AGRICULTURAL DEMONSTRATION PROJECT

FACILITIES PLAN FOR NORTH MONTEREY COUNTY

PROPOSED AGRICULTURAL IRRIGATION DEMONSTRATION PROGRAM

Prepared for

MONTEREY PENINSULA WATER POLLUTION
CONTROL AGENCY
Monterey County, California

19 March 1976

Prepared by

ENGINEERING-SCIENCE, INC.
600 Bancroft Way
Berkeley, California 94710

Source: Engineering Science, Inc., 1976c.

INTRODUCTION

During the last twelve months a large number of wastewater management alternatives for North Monterey County have been examined as part of the on-going facilities planning effort. A single alternative has now emerged as the most preferable course of action for the area; this alternative (designated Alternative 166 in the preceding analyses) involves treatment of wastewaters from Pacific Grove, Monterey, Seaside, Fort Ord, Salinas and Castroville at a 2-MGD facility near the mouth of the Salinas River with summertime crop irrigation with treated wastewater and wintertime disposal to the ocean.

Although the reclamation and crop irrigation element of the wastewater management system has many potential benefits, such as providing a means of ameliorating the Monterey Peninsula's water shortage many doubts remain in the minds of both public health agency officials and the farmers who might use the reclaimed water.

Because implementation of a wastewater management system as complex as the one proposed will take many years, it is both possible and desirable to stage its construction. Thus the opportunity exists to conduct an agricultural irrigation demonstration program, concurrent with other planning and design activities which would be designed to answer the questions that remain with respect to crop irrigation with reclaimed wastewaters.

OBJECTIVE

The program objective is to answer satisfactorily the following questions:

- Can food crops (such as lettuce and artichokes) with the normally expected quality (i.e., product safety for consumption as food without any restrictions) be grown using the reclaimed wastewaters generated in the Study Area?
- Will use of reclaimed wastewater result in any long-term deterioration of land quality, surface water quality or groundwater quality?
- Can reclaimed wastewater be used safely without hazard to farmworkers or consumers?

- Does use of reclaimed wastewater require any special agricultural management practices?
- Can the potential crop marketing problems be overcome?
- Will use of reclaimed water result in any significant economic impact due to decreased or increased production or changes in cropping patterns?

It should be noted that information emerging from the program would be to a considerable degree site-specific. The answers arrived at may hold only for this particular wastewater, soil type, crop type and agricultural practice.

A preliminary analysis indicates that it will be necessary to:

- grow crops commonly grown in the proposed reuse area on soils typically utilized and using treated wastewater;
- produce farm-scale crops, in addition to the small size replicate plots used in the quantitative trials, in order to establish feasibility of large-scale operations;
- provide a needed long-term perspective through successive production of the common crops for a number of successive years, estimated to be five years;
- analyze the edible parts of harvested crops for trace elements of concern and for pathogenic indicators as a means of ascertaining consumer safety from toxicological and pathogenic viewpoints:
- test soils and plant matter after irrigation for determination of earliest field reentry periods by testing for accumulation of viruses, bacteria and chemicals;
- sample and test waters leaching below the root zone for constituents which might pollute groundwater;
- sample crops and soils at random in various parts of Salinas Valley to test for bacteriological indicators as a check for the validity of the controls used and standards employed;
- determine, probably in the later years of the project, marketability of the harvested crops;

- provide farmers and operators in the potential reuse areas ample opportunity for access to and observation of the demonstration plots, test results and all other information developed during the course of the project;
- gain experience in the conduct of the demonstration project which would be useful for application to the conduct of the full-scale reclamation of the waters when eventually implemented; and
- establish guidelines for an economical and efficient monitoring system to be used in the future full-scale reclamation project.

TECHNICAL APPROACH

Well-established agricultural investigation techniques and methodologies would be applied in the demonstration project, with the necessary controls over the cultural practices so as to insure reliability and reproducibility of the results. Adequate replications (three or four, depending on soil uniformity) would be provided to determine satistical significance of the differences (if any) observed. Many of the cultural practices will be maintained constant for all plots and will represent typical farming practices locally employed by farmers as closely as possible. These practices will include fertilization; weed and pest control; irrigation methods, frequency and depth; soil preparation and cultivation; harvest, etc. The soil type would also be a constant, presumably a Pacheco clay loam, typical of most of the Castroville Irrigation Project area.

The independent variables which would be controlled are:

(1) Four irrigation water types

- Well water commonly used
- A high quality water (either trucked in from Nacimiento Reservoir or obtained from a local purveyor)
- Filtered secondary wastewater effluent from Castroville and/or from regional interceptor, until the regional plant is completed
- A reclaimed wastewater meeting the requirements of Title 22 of the California Administrative Code

(2) Two crops

- Artichokes
- Lettuce (red, romaine, head)

(3) Two nitrogen fertilizer application rates

The dependent variables which would be monitored, sampled, analyzed, measured and observed are:

(1) Yield of crops (tons per acre)

(2) Quality of crops for market (color, maturity, deficiency symptoms, shape, taste, shelf life and protein content)

(3) Plant tissue composition

- Nitrogen
- Phosphorus
- Potassium
- Boron
- Sulfur
- Zinc
- Cadmium
- Copper
- Nickel

(4) Pathogenic indicators on the crops' edible parts

- Total coliform
- Fecal coliform
- Viruses

(5) Reentry period after each irrigation by daily measurement of bacterial die-off in soils and plants

(6) Quality of waters leaching below the root zone

- Nitrate
- Total dissolved solids

- Hardness
- Boron

(7) Heavy metals accumulation in soil (water-soluble and total)

- Zinc
- Cadmium
- Copper
- Nickel

(8) Mass balance on total salts and individual elements of special concern

(9) Soil permeability and infiltration rate before and during the program

(10) Periodic medical check-ups of farm workers and program personnel for toxicological and dermatological disorder symptoms

PROTOCOL, PROCEDURES AND EQUIPMENT

The detailed design of the program would be conducted in consultation with members of the academic community whose recent intensive involvement with studies of heavy metals accumulation, nitrate movement and pathogen survival can be of value in making the demonstration project most effective. The Monterey County Farm Advisor would be consulted, as necessary, on farming practices. Furthermore, the involvement of various regulatory agencies--EPA, CSWRCB, State Health Department, County Health Department, etc.--will be sought at the planning stages of the demonstration project, and these agencies will be kept informed of interim results and work progress.

It is envisioned that the demonstration program will be conducted simultaneously in two different parts, in order to maximize achievement of the objectives enumerated above. In one set of relatively small plots (each measureing approximately 50 by 100 feet), the variables of interest will be replicated in a manner that will permit valid statistical analysis of quantitative results (chemical composition of plant parts and soil, yields, microbiological contamination, etc.). In another, larger field, the crops commonly grown in the Study Area will be grown, on a relatively large scale, using the effluent most likely produced by the eventual treatment plant. This larger field will be of importance in providing and fine-tuning operational guidelines, monitoring needs and controls. It will also provide, after the first few years, clues to any possible variations in crop quality, maturity and marketability. It can be used as an example for prospective users of reclaimed water who may wish to see the results first-hand in their own neighborhood.

Site Selection and Preparation

It will be of importance to select a site where the crops proposed for the demonstration project are commonly grown, on a soil that is typical of most of the area and is uniform in depth, slope, surface texture and profile characteristics. It is envisioned that a suitable (20- to 40-acre) field will either be leased for an extended period (probably a minimum of five years) or simply be contracted for the agricultural operations and testing requirements under direct supervision of the Monterey Peninsula Water Pollution Control Agency.

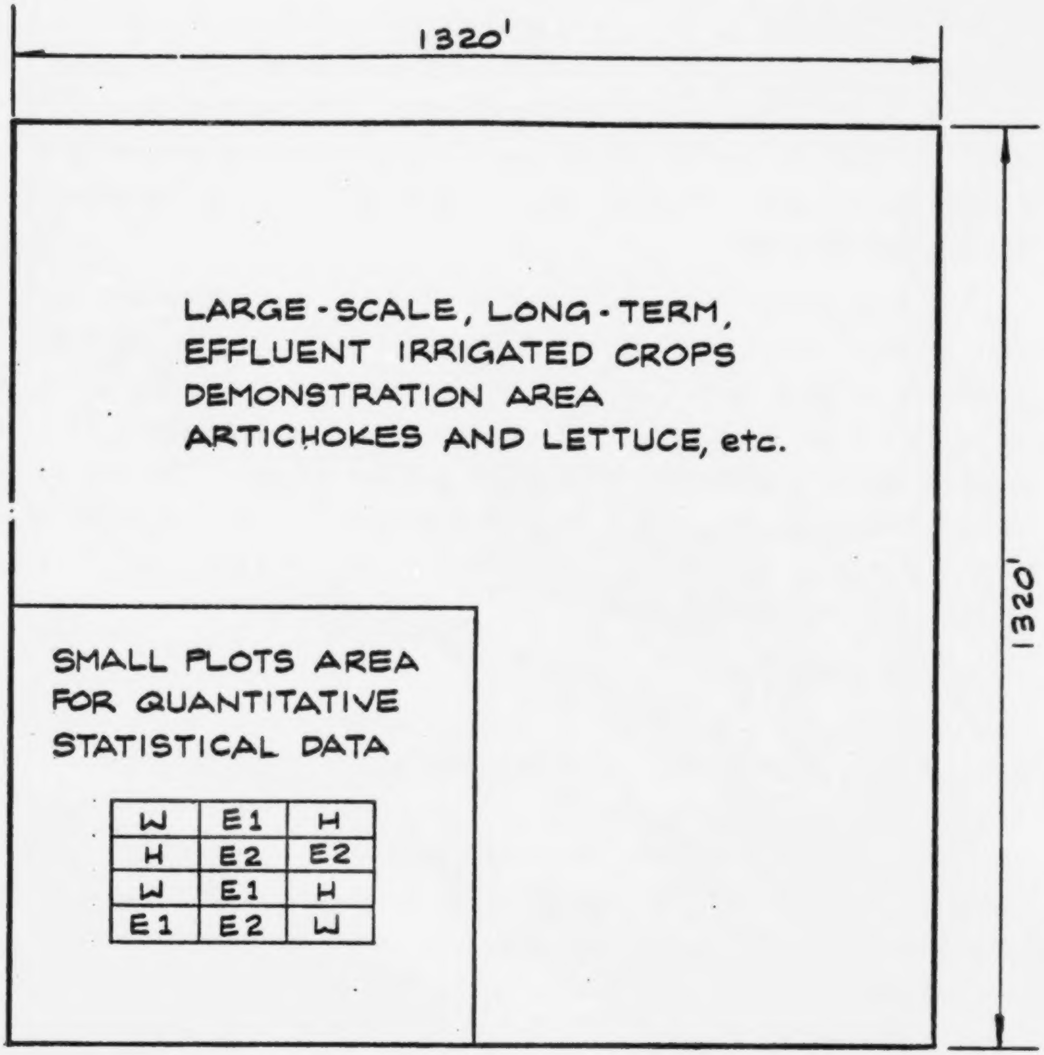
After the site has been selected, a field soil investigation involving hand-auger profiles at 100-foot grid corners and surface soil sampling (for texture, pH, organic content, permeability at different depths, color) will be conducted to determine soil uniformity or variations over the demonstration area. (It is expected that the demonstration program will be conducted entirely on Pacheco clay loam or Pacheco silty clay loam soils.) Heavy metals concentrations in soil samples will be determined in order to establish baseline conditions.

In the following sections, the plots designated for quantitative information gathering are described, and mechanisms for transfer and application of irrigation waters are discussed.

Water Source, Crop Type and Fertilizer Trial Plots

Specially designed trial plots will be set up for a five-year study of the effects of reclaimed water upon commonly grown crops in an area between the proposed treatment plant site and Castroville. The number of plots used is dependent upon available budget and soil uniformity in the selected site. A possible layout of the plots is shown on Figure 1.

FIGURE 1


1320'
1320'
LARGE-SCALE, LONG-TERM, EFFLUENT IRRIGATED CROPS DEMONSTRATION AREA ARTICHOKES AND LETTUCE, etc.
SMALL PLOTS AREA FOR QUANTITATIVE STATISTICAL DATA
W E1 H
H E2 E2
W E1 H
E1 E2 W

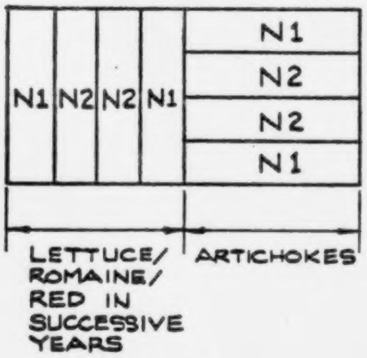
LEGEND

W : WELL WATER
H : A HIGH QUALITY WATER
E1 : FILTERED SECONDARY EFFLUENT
E2 : TITLE IV EFFLUENT

N1 : ~250 lb/a N
N2 : ~125 lb/a N

22

TYPICAL PLOT



Water Requirements

The four water types enumerated above will be supplied through (1) pumping from a well on or near the selected site; (2) trucking from the Salinas River and storage onsite; and (3) adding pilot treatment plants to the regional interceptor and eventually to the regional treatment plant conveying treated effluent.

It is estimated that approximately 80 acre-ft of reclaimed effluent will be needed during the seven-month irrigation season (an average of 18 inches for artichokes and 30 inches for other crops, each growing on about 20 acres). Over the seven-month irrigation season, this amount of effluent will be equal to an average of 125,000 gallons per day. The well water and the Salinas River waters will be needed to irrigate only three 50' x 100' plots, resulting in a maximum requirement of 0.86 acre-ft (281,000 gallons) through the irrigation season.

Irrigation Method

Artichokes are commonly irrigated by sprinklers in the Castroville area. Lettuce, on the other hand, is furrow irrigated. It would be most convenient for the demonstration program if the entire area were irrigated using the same irrigation method. For several reasons, the preferred method would be furrow irrigation. However, in the interest of maintaining flexibility and providing conditions that are similar to those that the farmers commonly encounter, it would be possible to use both methods. Adequate provisions against drift of sprinkled waters from one set of plots onto another would be necessary. Such provisions might include wide plot separation, physical barriers, use of low-pressure, large droplet nozzles and irrigation during night time, etc.

Methods of Analysis

Soils, edible plant tissues and percolating waters would be sampled with the computed frequency, replications and judicious sampling site and time selection necessary to minimize bias and maximize precision. Samples will be sent immediately to ES's Berkeley laboratory where they would be subjected to preservation, preparation and analysis techniques. All physical, chemical and the bulk of the biological test will be conducted at the ES Berkeley laboratory. Specialized virological examinations will be referred to a qualified laboratory for determination of total virus concentrations (plaque-forming units) in soils and on plant leaves. Coliform tests will be initiated in the field immediately upon sampling by inoculating the membrane filter. Samples will be carried to the ES Monterey office for completion of the analysis.

Soil analyses will be conducted in accordance with applicable methods published by the American Society of Agronomy. Water analyses will be performed as prescribed by *Standard Methods*.

Analyses for heavy metals (Zn, Cd, Ca, Ni) concentrations in the soil samples will be performed on two separate extracts of the samples; one obtained with 0.01N $Ca(NO_3)_2$ or 0.01N $Ca\ Cl_2$ solution, to represent the water soluble fraction (i.e., that available for plant uptake) of the heavy metals; and the other extracted with DTPA to represent total metals in the soil.

Plant tissues will be digested and examined for the total amounts of metals (Zn, Cd, Cu and Ni) present. Care will be taken to eliminate or compensate for the undesirable matrix effects caused by the relatively large amounts of soluble and insoluble solids present in samples of this type.

APPENDIX M

PROPOSED PROJECT COST DATA

Table M-1*

COST ESTIMATES FOR STAGE II

Cost Component	Estimated Cost, $(1)
Interceptors	
Monterey to Seaside	493,000
Seaside to Fort Ord	1,725,000
Fort Ord to Reservation Road	1,742,000
Marina to Reservation Road	225,000
Reservation Road to Regional Plant	1,747,000
Salinas to Regional Plant	3,840,000
Castroville to Regional Plant	1,042,000
Subtotal	10,824,000
Pumping Plants	
Monterey P.S.	
Structure	–
Pumps and Equipment	825,000
Seaside P.S. #1	
Structure	470,400
Pumps and Equipment	873,600
Seaside P.S. #2	
Structure	470,400
Pumps and Equipment	873,600
Marina P.S. #1	
Structure	–
Pumps and Equipment	116,000
Marina P.S. #2	
Structure	–
Pumps and Equipment	100,000
Reservation Road P.S.	
Structure	501,760
Pumps and Equipment	1,066,240
Salinas P.S.	
Structure	–
Pumps and Equipment	1,600,000
Castroville P.S. #1	
Structure	448,000
Pumps and Equipment	448,000
Castroville P.S. #2	
Structure	224,000
Pumps and Equipment	224,000
Subtotal	7,793,000
Outfall	
Land Portion	2,840,000
Ocean Portion	5,250,000
Subtotal	8,090,000
TOTAL	26,707,000

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(1) Costs as of 1 January 1976.

* Source: Engineering Science, Inc., 1976d.

Table M-1*

COST ESTIMATES FOR STAGE II

Cost Component	Estimated Cost, $(1)
Interceptors	
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Structure	-
Pumps and Equipment	825,000
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Structure	470,400
Pumps and Equipment	873,600
Seaside P.S. #2	
Structure	470,400
Pumps and Equipment	873,600
Marina P.S. #1	
Structure	-
Pumps and Equipment	116,000
Marina P.S. #2	
Structure	-
Pumps and Equipment	100,000
Reservation Road P.S.	
Structure	501,760
Pumps and Equipment	1,066,240
Salinas P.S.	
Structure	-
Pumps and Equipment	1,600,000
Castroville P.S. #1	
Structure	448,000
Pumps and Equipment	448,000
Castroville P.S. #2	
Structure	224,000
Pumps and Equipment	224,000
Subtotal	7,793,000
Outfall	
Land Portion	2,840,000
Ocean Portion	5,250,000
Subtotal	8,090,000
TOTAL	26,707,000

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(1) Costs as of 1 January 1976.

* Source: Engineering Science, Inc., 1976d.

Table M-2*

COST ESTIMATES FOR STAGE III

Cost Component	Estimated Cost, $(1)
Regional Secondary Treatment Plant	
Comminute and Grit Chamber	
Structure	296,600
Equipment	1,323,700
Primary Clarifiers	
Structure	1,979,600
Equipment	4,122,700
Aeration Basin	
Structure	1,719,000
Equipment	1,927,300
Chlorination-Dechlorination Basin	
Structure	767,900
Equipment	273,600
Sludge Thickener	
Structure	85,500
Equipment	915,200
Sludge Dewatering	
Structure	340,800
Equipment	1,777,800
Secondary Clarifiers	
Structure	2,180,000
Equipment	3,912,500
Sludge Digestors	
Structure	2,166,400
Equipment	1,689,000
Control Building	492,700
Pilot Plant	286,500
Demolition	2,000,000
TOTAL	28,256,800

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(1) Costs as of 1 January 1976.

* Source: Engineering Science, Inc., 1976d.

Table M-3+

FORM 7a
ANNUAL REVENUE NEEDED – INDUSTRIAL

MUNICIPALITY Stage II - Monterey Peninsula WPCA DATE 30 September 1976
FIRST FULL YEAR OF OPERATION 1982/83

A Number of Units	B Industrial Groups or Single Industrial Users	C SIC Group No.	D Capital Cost Grant Funded C_{gf}	E Capital Cost Non-Grant Funded C_{nf}	F Total Capital Cost C_{tc}	G Int. Cost	G-1 I/I Dist.	H Capital Cost Grant Funded Interceptor Outfall C_{io}	I O & M Cost First Full Year Operation C_t	J Gen. Administration & Accounting Cost C_a	K Total Annual Revenue Needed R_n*	L Average Revenue Needed R_{na}
1	Artichoke Industries	20	913	236	1,149	766	230	45	1,782	2.40	4,768	4,768
1	Pacific Foods	20	2,186	553	2,740	1,826	549	86	4,129	2.40	11,198	11,198
1	Salinas Tallow Works	20	10,465	2,642	13,108	8,737	2,628	426	19,462	2.40	53,236	53,236
1	Peter Paul, Inc.	20	9,369	2,257	11,626	7,750	2,331	86	18,173	2.40	47,962	47,962
1	J.M. Smuckers, Inc.	20	2,965	731	3,696	2,464	741	82	5,506	2.40	14,989	14,989
1	Distron, Inc.	20	1,982	482	2,464	1,642	494	37	3,486	2.40	9,750	9,750
6	SUB TOTALS		27,880	6,901	34,783	23,185	6,973	762	52,538	14	141,903	141,903

RATIO 0.651997

* - Includes Infiltration/Inflow capital cost distribution and a 20 percent increase to cover the costs of facilities cost equalization program.

+ Source: Engineering Science, Inc., 1976.

Table M-4*

FORM 7b
ANNUAL REVENUE NEEDED - NON-INDUSTRIAL

MUNICIPALITY Stage II - Monterey Peninsula WPCA DATE 30 September 1976
FIRST FULL YEAR OF OPERATION 1982/83

A Number of Users	B Commercial, Residential and Special Groups		D Capital Cost Grant Funded C_{gf}	E Capital Cost Non-Grant Funded C_{nf}	F Total Capital Cost C_{tc}	G Interest Cost I_c	H I/I Dist.	I O & M Cost First Full Year Operation C_t	J Gen. Administration & Accounting Cost C_a	K Total Annual Revenue Needed R_n 1	L Average Revenue Needed R_{na}
44,200	Single Family Residence		431,940	119,930	551,871	367,863	110,629	775,485	106,080	2,294,314	52
21,700	Multi-Family Residence		122,665	34,059	156,724	104,468	31,417	220,391	52,080	678,096	31
2,500	Mobile Homes		11,634	3,228	14,863	9,907	2,979	20,767	6,000	65,419	26
7,000	Hotel/Motel Rooms		27,289	7,626	34,915	23,273	6,999	31,266	16,800	135,904	19
2,131	General Commercial Offices		17,578	4,882	22,461	14,972	4,503	31,937	5,114	94,784	44
1,363	Retail Store/Groceries		5,616	1,559	7,175	4,783	1,438	10,142	3,271	32,171	24
289	Medical/Dental Offices		4,826	1,338	6,165	4,109	1,236	8,566	694	24,924	86
365	Cafe/Restaurant/Bars		30,194	8,383	38,578	25,715	7,733	54,262	876	152,597	418
273	Service Station/Garages		5,405	1,501	6,907	4,604	1,385	9,810	655	28,033	103
175	Barber/Beauty Shops		1,192	329	1,522	1,014	305	2,200	420	6,553	37
72	Laundry/Cleaners		14,886	4,133	19,020	12,678	3,813	26,915	173	75,119	1,043
190	Light Industry		2,383	660	3,044	2,029	610	4,283	456	12,506	66
96	Churches		2,018	559	2,577	1,717	517	3,516	230	10,268	107
23	Rest Home/Convalescent Hosp.		1,902	527	2,430	1,619	487	3,516	55	9,728	423
5	General Hospital		1,056	292	1,349	899	270	1,793	12	5,188	1,038
72	Public Schools		45,765	12,698	58,463	38,970	11,720	60,895	173	204,265	2,837
17	Animal Hospital/Boarding		250	69	319	213	64	478	41	1,338	79
14	Bakeries		365	101	466	311	93	695	34	1,919	137
14	Theaters		825	229	1,055	703	211	1,651	34	4,385	313
15	Car Wash		651	179	831	553	167	1,173	36	3,312	221
4	Bowling		250	69	319	213	64	478	10	1,301	325
64	Warehouse/Lumber		961	266	1,227	818	246	1,722	154	5,000	78
7	Bottling Works		2,903	805	3,709	472	744	5,310	17	14,702	2,100
	SUB TOTALS 7b		732,554	203,422	935,990	623,903	187,630	1,277,251	193,415	3,861,826	
	SUB TOTALS FROM FORM 7a		27,880	6,901	34,783	23,185	6,973	52,538	14	141,903	
	SPECIAL CLASSIFICATIONS										
	INFILTRATION/INFLOW 2		115,070	50,919	165,990	110,645	0	0			
	FUTURE CAPACITY		190,574	52,911	243,486	162,301	48,810	0		545,516	
3	FEDERAL FACILITIES		143,631	39,878	183,509	0	36,787	261,203	8	489,003[3]	
	SUB TOTALS		449,275	143,708	592,985	296,131	85,597	261,203	8	1,176,419	
	TOTALS		1,209,709	354,031	1,563,758	920,934	280,200	1,590,992	193,437	5,038,245	

RATIO 0.666575

1 - Includes Infiltration/Inflow capital cost distribution and a 20 percent increase to cover the cost of a facilities cost equalization program.
2 - Total of Infiltration/Inflow costs in columns F and G is reallocated in column H to all users.
3 - Costs for Fort Ord are not increased by 20 percent for facilities cost equalization program.

* Source: Engineering Science, Inc., 1976.

Table M-5

DETAILED COST ESTIMATES FOR ALTERNATIVES

Alterna- tive Number	Conveyance ($ x 10^6)				Conveyance ($ x 10^6)				Conveyance ($ x 10^6)				Totals ($ x 10^6)	
	Construction				Construction				Construction					
	Capital	Present Worth	Salvage Value[1]	PW O&M[2]	Capital	Present Worth	Salvage Value[1]	PW O&M[2]	Capital	Present Worth	Salvage Value[1]	PW O&M[2]	Total Capital	Total Present Worth[1]
1	17.72	13.51	-2.56	3.49	28.00	19.96	-2.74	19.05	8.09	6.17	-1.46	.15	53.81	55.57
166	17.72	13.51	-2.56	3.49	37.00	24.53	-4.20	19.98	9.94	7.11	-1.87	.12	64.66	60.11
170	17.72	13.51	-2.56	3.49	41.48	28.03	-4.47	21.91	22.76	15.77	-5.02	.56	81.96	71.22
171	17.72	13.51	-2.56	3.49	28.00	19.96	-2.74	19.65	5.81	3.52	-1.92	.60	51.53	53.51
134	17.72	13.51	-2.56	3.49	45.43	31.02	-4.87	24.22	6.24	4.17	-1.34	.40	69.39	68.04

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[1] 1996 present worth.

[2] 20-year present worth.

PUBLIC AGENCY GUIDELINES -- REGULATIONS

APPENDIX N

EPA-SWRCB WATER QUALITY CONTROL PLANS, GUIDELINES, RECOMMENDATIONS

CENTRAL COASTAL WATER QUALITY CONTROL PLAN
REPORT RECOMMENDATIONS*

Salinas River Sub-Basin

The extensive Salinas River Sub-basin includes the Monterey Peninsula and southern coastal area of Monterey Bay, the City of Salinas, agricultural and small urban centers of the Salinas Valley, and recreational developments in the upper watersheds.

Monterey Peninsula-Salinas Region

The implementation plan for the Monterey Peninsula-Salinas area calls for consolidation of Monterey Peninsula, Salinas, and Castroville area municipal wastewater flows with construction of a regional treatment plant and outfall facility for discharge to Central Monterey Bay with reuse of reclaimed wastewater for crop irrigation and possible enhancement of the lower Salinas River.

Staging can be accomplished in various ways; major elements of a staged program include:

1. Construct pumping station and interceptor sewer from Pacific Grove to the City of Monterey treatment plant during 1975. Enlarge and upgrade the Monterey facility to provide level II treatment during 1975 and abandon the existing Pacific Grove treatment plant. Discharge combined effluent flow through the existing Monterey outfall facility as an interim measure. Should reclamation be desired at Pacific Grove for such uses as golf course irrigation, a separate reclamation facility could be built for this purpose for treatment of wastewater flows diverted from the interceptor as demands for reclaimed water warrant.

2. Conduct further oceanography and marine biology studies during 1975 pertaining to a Central Monterey Bay outfall to be located somewhere near the mouth of the Salinas River.

3. Construct an interceptor sewer from Monterey through Seaside, Fort Ord, and Marina to a point near the Salinas River mouth consistent with the outfall alignment by 1977. Provide for local reclamation as justified by local needs.

4. Construct interceptor sewer from Salinas to the Monterey Bay shore consistent with the outfall alignment by 1977. Provide for local reclamation as justified by local needs.

5. Construct outfall into Central Monterey Bay from a point near the mouth of the Salinas River by 1977; outfall size should be sufficient to transport future wastewater flows from the Monterey Peninsula, Salinas and Castroville areas.

6. Convey wastewater effluents from the Monterey Peninsula treatment plants in the interceptor for outfall discharge to Central Monterey Bay by 1977; convey wastewater effluents from the Salinas Municipal treatment plants to the outfall by 1977; consolidated flows are required to meet level II treatment standards. At present flows, this would eliminate about 10 mgd from five local outfall discharges to the south pocket of Monterey Bay and 6 mgd from direct discharges to the Salinas River.

7. Construct interceptor from Castroville to the outfall location after existing unsewered areas in the Castroville area, including Moss Landing, Oak Hills and Prunedale, are sewered. These unsewered areas should develop sewering programs consistent with future consolidation with Castroville and the Monterey Peninsula-Salinas plan; these sewerage programs should be identified in terms of sewerage feasibility reports by 1977.

8. Construct a regional wastewater treatment and /or reclamation facility to permit abandonment of existing municipal treatment plants; reclamation plant construction consistent with level VI treatment would be initiated in the first stage of the regional wastewater treatment facility construction if reclaimed water demand is established; otherwise regional facility construction should be limited to level II treatment processes with provision for future upgrading. Irrigation reuse on local crops may require level III or level IV treatment and demonstrations of such reuse should be initiated prior to 1977 to determine extent of acceptance in the local farming community and evaluate public health aspects of this program. Begin construction of regional treatment plant by 1977.

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* Source: California State Water Resources Control Board, 1975a.

Options are available in the program concerning the sequence of events and extent of consolidation to be achieved during the planning period; i.e., until the year 2000. For example, the timing for construction of interceptor sewers from the Monterey Peninsula or Salinas could be different; either can proceed first or construction can be concurrent. However, construction of the outfall must proceed with the first interceptor project, and the sizing of the outfall must be consistent with total future consolidation. In the Castroville area there are unsewered areas which may be sewered in the future; these facilities should be planned in harmony with the consolidation program. Sewerage feasibility studies should be performed to define more closely the staging of sewering of these areas and to relate sewer projects to future facility alignments. For example, Moss Landing should convey wastewaters southward for interim disposal to land or proceed directly toward consolidation with Castroville. Castroville may delay consolidation with Monterey-Salinas while sewerage facilities are being developed for areas to the north and east; however, land disposal is recommended for the Castroville area as an interim measure and for possible demonstration of irrigation reuse potential and to determine acceptance of such reuse to local farmers in this area. Elimination of discharge to Templedero Slough should be accomplished by 1976.

In the Salinas area the Gabilan Acres-Bolsa Knolls area should be tied in with the City of Salinas system, and the Toro Park plant should be abandoned by 1977 and wastewaters from this area should be conveyed to Salinas. A further consideration for Salinas is the possible retention of the industrial treatment facility which would avoid sizing interceptors for seasonal peak flows from seasonal wastes generated by processors of agricultural crops; long-term retention of the industrial waste facility should be evaluated at the project report level in terms of cost-effective aspects as well as impact on reclamation, both locally and on the reclamation features of the consolidation plan. Mineral quality and the timing of peak industrial flows which coincide with harvest periods may be incompatible with reclamation for irrigation reuse near Castroville. Although this facility could be retained, the discharge of industrial wastes to the regional interceptor system during peak periods could be accommodated.

In the Monterey area, the existing Monterey Peninsula Water Pollution Control Agency (MPWPCA) or a newly formed sanitation district could include Castroville CSD, Marina CWD, the City of Monterey, the City of Pacific Grove, Seaside CSD, and the City of Salinas as participating agencies. It is recommended that the tri-cities group (Monterey, Seaside and Pacific Grove) get together with Fort Ord, Marina, Salinas, and Castroville to decide on the character of the implementing agency and establish working arrangements for early aspects in the staging of the implementation plan, such as ocean outfall studies and irrigation reuse demonstrations. Joint powers agreements could be used initially; however, a management agency is envisioned which would have broader financing powers.

The discharge of wastes which do not comply with the following conditions are prohibited:

1. Wastes discharged to surface waters shall be essentially free of toxic substances, grease, oil, and phenolic compounds.
2. Wastes discharged to groundwaters shall be free of toxic substances in excess of accepted drinking water standards; taste, odor, or color producing substances and nitrogenous compounds in quantities which could result in a groundwater nitrate concentration above 45 mg/l.
3. Waste discharges shall not contain materials in concentrations which are hazardous to human, plant, animal, or aquatic life.

The discharge of elevated temperature wastes in excess of the liquids specified in Chapter 4 Water Quality Objectives into COLD intrastate waters is prohibited.

The discharge of soil, silt, bark, slash, sawdust or other organic and earthen materials from any logging, construction, or associated activity of whatever nature into any stream in the basin in quantities deleterious to fish, wildlife, and other beneficial uses is prohibited.

The placing or disposal of soil, silt, bark, slash, sawdust or other organic and earthen materials from any logging, construction, or associated activity of whatever nature at locations above the anticipated high-water line of any stream in the basin where they may be washed into said waters by rainfall or runoff in quantities deleterious to fish, wildlife and other beneficial uses is prohibited.

Wasters Subject to Tidal Action. Waste discharges to the following areas are prohibited:

1. Effective July 1, 1977, in Monterey Bay, northern and southern extremes within the following areas: inshore from a line extending from Santa Cruz Point to the mouth of the Pajaro River; and inshore from a line extending from Point Pinos to the mouth of the Salinas River; and the offshore area within a three-mile radius of Point Pinos.
2. Carmel Bay, within 1000 feet from the Point Lobos Preserve of the State Department of Parks and Recreations, as recorded in 1970.
3. Tidal waters within 1000 feet of the coast and 100-foot depth contour, measured from mean low water. An exception to this prohibition may be allowed by the Board in prescribing waste discharge requirements after finding that all beneficial water uses will otherwise be protected.

The discharge of any radiological, chemical, or biological warfare agent or high level radioactive waste into the ocean is prohibited.

The discharge of wastes into Areas of Special Biological Significance or close enough to such areas to alter their natural water quality conditions is prohibited.

The discharge of municipal and industrial waste sludge and sludge digester supernatant directly to the ocean, or into a waste stream that discharges to the ocean without further treatment is prohibited.

The bypassing of untreated waste to the ocean is prohibited.

No person, whether engaged in commerce or otherwise, shall place, throw, deposit or discharge, or cause to be placed, thrown, deposited or discharged on or in tidal waters any untreated waste or waste matter, except vessel wash down water, from any vessel.

The discharge of oil or grease from other than natural sources which produces a visible or measurable effect to tidal waters of the basin is prohibited.

New thermal waste discharges to coastal waters, enclused bays and estuaries having a maximum temperature greater than 4°F above the natural temperature of the receiving water are prohibited.

Source: California State Water Resources Control Board, 1975a.

CENTRAL COASTAL WATER QUALITY CONTROL PLAN DISCHARGE PROHIBITIONS*

Discharge Prohibitions

Due to unique cultural, scenic, aesthetic, historical, scientific, and ecological values of the Central Coastal Basin, and the necessity to protect the public health and the desire to achieve water quality objectives, the Regional Water Quality Control Board has established certain discharge prohibition.

All Waters. The discharge of oil or any residual products of petroleum to the waters of the State, except in accordance with waste discharge requirements, or other provisions of Division 7 of the California Water Code is prohibited.

Inland Waters. Waste discharges to the following inland waters are prohibited:

1. All surface, fresh water impoundments and their immediate tributaries.
2. All surface waters within the San Lorenzo River, Aptos-Soquel, and San Antonio Creek Sub-basins and all water contact recreation areas located in fresh waters except where benefits can be realized from direct discharge of reclaimed water.
3. All dead end sloughs receiving little flushing action from land drainage or natural runoff.
4. All coastal surface streams and natural drainage ways that flow directly to the ocean within the Santa Cruz Coastal, Monterey Coastal, San Luis Obispo Coastal from the Monterey county line to the northern boundary of San Luis Obispo Creek drainage, and the Santa Barbara Coastal Subbasins except where discharge is associated with an approved wastewater reclamation program.
5. The Santa Maria River downstream from the Highway 1 bridge.
6. The Santa Ynez River downstream from the salt water barrier.

In addition, discharge from individual sewage disposal systems, including but not limited to septic tank seepage pits and adsorption fields, cesspools, pit privies, chemical toilets, etc., is prohibited:

1. On all parcels of land within the projected horizontal distance of 200 feet of all reservoirs and impoundments as determined by the spillway elevation.
2. Within a reservoir watershed, on individual parcels of land of less than 2.5 acres beyond the projected horizontal distance of 200 feet from the high water elevation of reservoirs and impoundments, as determined by the spillway elevation.
3. On individual parcels of land where any part of the disposal system is within a horizontal distance of 100 feet of surface streams, natural watercourses or domestic water supply wells.
4. On parcels of land less than 0.5 acres in new divisions of land not located on reservoir watersheds where depth of usable groundwater is less than 100 feet below ground surface unless sufficient engineering justification is provided to prove beneficial uses will be protected.

The discharge of solid waste materials is prohibited under the following conditions and/or in specific locations:

1. Any Class I solid waste material to any location other than Class I solid waste disposal site.
2. Any Class II solid waste materials to any location other than Class I or II solid waste disposal sites.
3. Solid wastes shall not be discharged to rivers, streams, creeks, or any natural drainage ways or flood plains of the foregoing.

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* Source: California State Water Resources Control Board, 1975a.

Table N-1

TREATMENT REQUIREMENTS FOR SELECTED DISPOSAL OPTIONS

Treatment level	Type of treatment	Treatment processes	Appropriate disposal option
I	Physical-chemical with disinfection[a]	Sedimentation with chemical addition, chlorination, dechlorination	Possible ocean discharge option where secondary treatment not cost-effective
II	Biological secondary with disinfection[a]	Sedimentation, carbonaceous oxidation, chlorination, dechlorination	Ocean discharge. Irrigation and/or percolation systems, where nitrate is not a problem in groundwater
III	Biological nitrification with disinfection	Sedimentation, biological oxidation with nitrification, chlorination, dechlorination	Discharge to streams where recreational use is restricted
IV	Biological nitrification, filtration with disinfection	Sedimentation, biological oxidation with nitrification, effluent filtration, chlorination, dechlorination	Discharge to streams where unrestricted recreational use occurs
V	Biological nitrification and denitrification with disinfection	Sedimentation, biological oxidation with nitrification, denitrification, chlorination	Irrigation and/or percolation systems where nitrate is a problem in groundwater
VI	Physical-chemical-biological with disinfection	Sedimentation with chemical addition, oxidation with nitrification, denitrification, effluent filtration, chlorination, dechlorination	Recreational impoundments or discharge where eutrophication is a problem
VII	Partial demineralization or lime soda softening of water supply plus biological nitrification and denitrification of wastewater with disinfection	Water supply - lime soda softening or partial demineralization. Wastewater - sedimentation, biological sedimentation, biological oxidation with nitrification, denitrification, chlorination	Spray irrigation and percolation systems where groundwater nitrate and TDS concentrations are a problem
VIII	Partial demineralization of wastewater, biological nitrification and denitrification with disinfection	Sedimentation, biological oxidation with nitrification, denitrification, effluent filtration, partial demineralization, chlorination	Spray irrigation and percolation systems where groundwater nitrate and TDS concentrations are a problem

[a] Deep water ocean discharges where the effluent field is normally submerged may not require continuous disinfection.

Source: California State Water Resources Control Board, 1975.

STATE WATER RESOURCES CONTROL BOARD POLICIES GUIDING DEVELOPMENT OF PROJECT ALTERNATIVES

1. Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California", October, 1969.
2. "Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California", May 18, 1972.
3. Resolution No. 72-45, "Water Quality Control Plan for Ocean Waters of California", July 6, 1972.
4. Resolution No. 74-73, "Water Quality Control Policy for the Enclosed Bays and Estuaries of California", May 16, 1974.
5. Resolution No. 75-21, "Approval of Water Quality Control Plans for the Central Coast Basin....", March 20, 1975.

Table N-2

BENEFICIAL USES OF WATERS WITHIN STUDY AREA*

	Municipal	Agricultural	Industrial Processing	Industrial Service	Groundwater Recharge	Water Contact Recreation	Non-Contact Recreation	Wildlife Habitat	Cold Freshwater Habitat	Warm Freshwater Habitat	Fish Migration	Fish Spawning	Marine Habitat	Shellfish Harvesting	Navigation	Ocean Commercial and Sport Fishing	Preservation of Rare and Endangered Species
Salinas River above Spreckels	x	x		x	x	x	x	x	x	x	x						
Salinas River below Spreckels							x	x		x	x						
Elkhorn Slough				x		x	x	x					x	x	x	x	x
Monterey Harbor				x		x	x						x	x	x	x	x
Coastal Water North of Salinas River				x		x	x						x	x	x	x	x
Coastal Water South of Salinas River				x		x	x						x	x	x	x	

Source: California State Water Resources Control Board, 1975.

Table N-3

WATER QUALITY CRITERIA FOR BENEFICIAL USES^{a}

	MUNICIPAL		AGRICULTURE				INDUS-TRIAL-SERVICE^{c}	RECREATION		WILDLIFE HABITAT		FRESHWATER AQUATIC LIFE			FISH MIGRATION	MARINE LIFE		SHELLFISH HARVESTING
			EPA		RWQCB^{b}								RWQCB					
	EPA	RWQCB	Irrigation	Livest.	Irrigation	Livest.	RWQCB	RWQCB (Contact)	EPA	EPA	RWQCB	EPA	Cold^{d}	Warm	RWQCB	EPA	RWQCB^{e}	RWQCB
Temperature	Not to detract from potability		No limit					30°C	86°F	Maintain natural levels	5°F above natural		5°F above natural	5°F above natural	5°F above natural	2.0 (9-5)^{u} 1.0 (6-8)	5°F above natural	
Turbidity (JTU)	No limit	5/							Clarity-4 ft. Secchi		<10 or 10% above natural	<10% change in C.P.	<10 or 10% above natural	<10 or 10% above natural	<10 or 10% above natural		10% above natural	10% above natural
Suspended solids (mg/l)			No limit				5,000	20/100				80						
Total alkalinity (mg/l)	No limit									30-130	20	75% natural level	20	20	20			
Aluminum (mg/l)			5.0	5.0	5.0	5.0					0.1		0.1	0.1	0.1	0.01 x 96 hr LC_{50} ^{i}	0.1	0.1
Arsenic (mg/l)	0.1	0.10	0.10	0.2	0.1	0.2					0.01		0.01	0.01	0.01	0.05	0.01	0.01
Ammonia (mg/l)^{f}	0.5										0.025	0.02	0.025	0.025	0.025	0.4	0.025	0.025
Barium (mg/l)	1.0	1.0									0.5		0.5	0.5	0.5	1.0	0.5	0.5
Berylium (mg/l)		0.1/0.5	0.1	No limit	0.1											1.5		
Boron (mg/l)	1.0	1.0	0.75-2.0^{h}	5.0	0.5/2.0											0.1 x 96 hr LC_{50} ^{i}		
Chloride (mg/l)	250	250/600	No limit		175/350		600											
Chlorine (mg/l)^{g}			No limit								0.003	0.003^{o}	0.003	0.003	0.003	0.01	0.003	0.003
Cadmium (mg/l)	0.01	0.01	0.01	50 µg/l	0.01	0.05					0.003	0.003^{p}	0.03^{t}	0.03^{t}	0.003	0.01	0.0002	0.003
Chromium (mg/l)	0.05	0.05	0.1	1.0	0.10	1.0					0.05	0.03	0.05	0.05	0.05	0.1	0.05	0.01
Cobalt (mg/l)			0.05	1.0	0.05	1.0												
Carbon dioxide (mg/l)											15		15	15	15			
Copper (mg/l)	1	1.0/	0.20	0.5	0.2	0.5					0.01	0.10 x 96 hr LC_{50} ^{i}	0.03^{t}	0.03^{t}	0.01	0.05	0.01	0.01
Cyanide (mg/l)	0.2	0.2									0.005	0.05 x 96 hr LC_{50} ^{i}	0.005	0.005	0.005	0.01	0.005	0.005
Fluoride (mg/l)		0.8-1.7	2.0^{j}		1.0	2.0					1.5		1.5	1.5	1.5	1.5	1.5	1.5
$CaCO_3$ (mg/l)		500/					850											
Iron (mg/l)	0.3	0.3	5.0	No limit	5.0						0.5		0.5	0.5	0.5	0.3	0.5	0.5
Lead (mg/l)	0.05	0.05	5.0	0.1	5.0	0.1					0.01	0.03	0.03	0.03	0.01	0.02 x 96 hr LC_{50} ^{i}	0.01	0.01
Lithium (mg/l)			2.5		2.5											0.05		
Manganese (mg/l)	0.05	0.05/	0.20	No limit	0.2	0.01					0.02		0.02	0.02	0.02	0.01	0.02	0.02
Mercury (inorg.) (mg/l)	0.002 total	0.005		0.001		0.01					0.001	0.0002^{q}	0.0002^{q}	0.0002^{q}	0.001	0.1	0.0001	0.001
Molybdenum (mg/l)			0.01	No limit	0.01	0.5										0.05 x 96 hr LC_{50} ^{i}		
Nickel (mg/l)			0.2		0.2						0.002	0.02 x 96 hr LC_{50} ^{i}	0.4^{t}	0.4^{t}	0.002	0.1	0.002	0.002
$NO_3 + NO_2$ (mg/l as N)	10 NO_3 1 NO_2	10	No limit on NO_3	100 10 mg/l NO_2		100 10 NO_2							1.0					

	MUNICIPAL		AGRICULTURE				INDUS-TRIAL-SERVICE^c	RECREATION		WILDLIFE HABITAT		FRESHWATER AQUATIC LIFE			FISH MIGRATION	MARINE LIFE		SHELLFISH HARVESTING
	EPA	RWQCB	EPA		RWQCB^b		RWQCB	RWQCB (Contact)	EPA	EPA	RWQCB	EPA	RWQCB		RWQCB	EPA	RWQCB^e	RWQCB
			Irrigation	Livest.	Irrigation	Livest.							Cold^d	Warm				
pH (units)	5.0-9.0	6.5-8.3	4.5-9.0		6.5-8.3			6.5-8.3	5.0-9.0	6.0-9.0	7.0-9.2	6.0-9.0	7.0-8.5	7.0-8.5	6.5-8.5	6.5-8.5	7.0-8.5	7.0-8.5
Selenium (mg/l)	0.01	0.01	0.02	0.05	0.02	0.05					0.005		0.005	0.005	0.005	0.01	0.005	0.005
Silver (mg/l)	0.05	0.05									0.001		0.001	0.001	0.001	0.005	0.001	0.001
Sodium absorpt ratio					<6.0													
Sulfate (mg/l)	250	250/ 500					680											
Sulfide (mg/l)							1,000				0.002	0.002	0.002	0.002	0.002		0.002	0.002
TDS (mg/l)	No limit	500/ 1,500	500/1,000^k	3,000 soluble salts	700-2,000					No limit	1% ± natural for 24 hrs		1,500	1,500	1,500			
EC (micromhos)					<750						3,000		3,000	3,000	3,000			
Zinc (mg/l)	5	5/		25	2.0	25					0.02	0.003 x 96 hr LC_{50} ^{l}	0.2^t	0.2^t	0.02	0.1	0.02	0.02
Total coliform (per 100 ml)		100/ 10,000			5,000												1,000	70
Fecal coliform (per 100 ml)	2,000	20/ 2,000	1,000	1,000^l	1,000			200	2,000 avg. 4,000 max.	2,000								
Microorganisms (per 100 ml)	10,000			5,000^l						2,000								
Dissolved oxygen (mg/l)	No limit				2.0		75 COD				5.0	5.0-6.0^r	7.0	5.0	5.0	6.0	7.0 & 5.0^v	5.0
Total phosphorous (mg/l)	No limit							0.05	0.025-0.50^m				0.1	0.2		0.0001^x	0.2	
Total nitrogen (mg/l)								0.5					1.0	2.0			2.0	
MBAS (mg/l)		0.5						1.0-2.0										
Oil & grease (mg/l)		Virtually absent						0/5.0		No visible floating oils	0	No visible floating oils	0	0	0	No film, no on-shore oil deposit	None visible	
ABS (mg/l)	0.5										1.0		1.0	1.0	1.0		1.0	1.0
PCB's (mg/l)										No increase	0.0001	0.000002	0.0001	0.0001	0.0001		0.0001	0.0001
Pesticides										1 mg/kg DDT^w		0.01 x 96 hr LC_{50} ^{l}				0.01 x 96 hr LC_{50} ^{l}		

Source: Regional Water Quality Control Board, Central Coast Region, 1974 and 1974a; U. S. Environmental Protection Agency, 1973.

Footnotes for Table N-3

a RWQCB values shown are limiting concentrations unless otherwise specified; where two values appear (e.g., a/b) the first is the threshold value, the second is the short-term limit value. All single numers are limiting values. Limiting concentrations are suggested as 90 percentile limits, not to be violated by controllable factors more than 10 percent of the time. EPA values shown are maximum acceptable concentrations unless otherwise specified.

b Based primarily on National Academy of Sciences-National Academy of Engineers, Environmental Study Board ad hoc Committee on Water Quality Criteria; all values except boron and chloride are maximum acceptable concentrations.

c Cooling water requirements for fresh water once through.

d Includes preservation of rare and endangered species beneficial use.

e Includes ocean commercial and sport fishing beneficial use.

f Un-ionized or undissociated ammonia.

g Residual chlorine.

h .75 for sensitive crops; 1.0 for semi-tolerant; 2.0 for tolerant.

i LC_{50} is 50 percent lethal concentration using the most sensitive important species in the locality.

j 1.0 mg/l on sandy soil.

k For sensitive crops; 2,000-5,000 for tolerant crops.

l Coliforms; average of a minimum of 2 samples per month.

m 0.25 mg/l for lakes and reservoirs; .1 mg/l for streams; .05 mg/l at confluence.

n Maximum acceptable concentration in fish flesh.

o Chronic exposure; 0.05 mg/l for up to 30 minutes in any 24-hour period.

p In hard water (total hardness greater than 100 mg/l as $CaCO_3$); 0.04 mg/l in soft water.

q Total mercury; should not exceed 0.05 μg/l as an average value.

r 5.8 at 35°C and 6.8 at 1.5°C; varies with temperature between these extremes.

s For pesticides with no toxicity data; see Table F-3 for other pesticides.

t Hardwater (>100 mg/l $CaCO_3$) maximum; lesser amounts are acceptable for soft water (<100 mg/l $CaCO_3$)

u °C acceptable change; 9-5 is September to May and 6-8 is June to August.

v 7.0 is mean annual lowest concentration and 5.0 is lowest acceptable at any time.

w DDT insecticide limit, wet weight.

x Elemented phosphorous.

Table N-4

WATER QUALITY CRITERIA FOR MUNICIPAL USE: PESTICIDES, HERBICIDES, AND INSECTICIDES (MG/L)*

	Municipal Use		Freshwater Aquatic Use[c]
	RWQCB	EPA	RWQCB & EPA
	PESTICIDES		
Aldrin	0.017	0.001	.00001
Chlordane	0.003	0.003[a]	.00004
DDT	0.042	0.05	.000002
Dieldrin	0.017	0.001	.000005
Endrin	0.001	0.0005	.000002
Heptachlor	0.018	0.0001[b]	.00001
Heptachlor epoxide	0.018	0.0001	
Lindane	0.056	0.005	.00002
Methoxychlor	1.0	1.0[a]	.000005
Organophosphorous and Carbamate compounds (as parathion in cholinesterase inhibition)	0.1	0.1	
Toxaphene	0.005	0.005[a]	.00001
	HERBICIDES		
2, 4-D plus 2, 4, 5-T plus 2, 4, 5-TP	0.1		
2, 4-D		0.02	
	INSECTICIDES		
Diazinon			.000009
Dursban			.000001
Malathion			.000008
Parathion			.000001
TEPP			.0003
Carbaryl			.00002

* i.e., ppm.

[a] Adjusted for organoleptic effects.

[b] Adjusted for interconversion to H. epoxide.

[c] Recommended concentrations of insecticides and pesticides in whole (unfiltered) water sampled at any time and any place. Concentrations were determined by multiplying the acute toxicity values for the more sensitive species by an application factor of 0.01. Represents RWQCB salt water habitat standards also.

Source: Regional Water Quality Control Board, Central Coast Region, 1974a; U. S. Environmental Protection Agency, 1973.

Table N-5

FEDERAL SECONDARY TREATMENT EFFLUENT REQUIREMENTS

		Value	
Parameter	Unit	Monthly Average	Weekly Average
Biochemical Oxygen Demand (five day)	mg/l	30	45
Suspended Solids	mg/l	30	45
pH		6.0 to 9.0	

Source: Federal Register, Vol. 40, No. 159 - Friday, August 15, 1975.

APPENDIX O

CALIFORNIA DEPARTMENT OF HEALTH WASTEWATER RECLAMATION CRITERIA AND GUIDELINES

WASTEWATER
RECLAMATION CRITERIA

An Excerpt from the

CALIFORNIA ADMINISTRATIVE CODE
TITLE 22, DIVISION 4
ENVIRONMENTAL HEALTH

1975

STATE OF CALIFORNIA
DEPARTMENT OF HEALTH
Water Sanitation Section
2151 Berkeley Way, Berkeley 94704

CHAPTER 4. RECLAMATION CRITERIA

Article 1. Definitions

60301. **Definitions.** (a) **Reclaimed Water.** Reclaimed water means water which, as a result of treatment of domestic wastewater, is suitable for a direct beneficial use or a controlled use that would not otherwise occur.

(b) **Reclamation Plant.** Reclamation plant means an arrangement of devices, structures, equipment, processes and controls which produce a reclaimed water suitable for the intended reuse.

(c) **Regulatory Agency.** Regulatory agency means the California Regional Water Quality Control Board in whose jurisdiction the reclamation plant is located.

(d) **Direct Beneficial Use.** Direct beneficial use means the use of reclaimed water which has been transported from the point of production to the point of use without an intervening discharge to waters of the State.

(e) **Food Crops.** Food crops mean any crops intended for human consumption.

(f) **Spray Irrigation.** Spray irrigation means application of reclaimed water to crops by spraying it from orifices in piping.

(g) **Surface Irrigation.** Surface irrigation means application of reclaimed water by means other than spraying such that contact between the edible portion of any food crop and reclaimed water is prevented.

(h) **Restricted Recreational Impoundment.** A restricted recreational impoundment is a body of reclaimed water in which recreation is limited to fishing, boating, and other non-body-contact water recreation activities.

(i) **Nonrestricted Recreational Impoundment.** A nonrestricted recreational impoundment is an impoundment of reclaimed water in which no limitations are imposed on body-contact water sport activities.

(j) **Landscape Impoundment.** A landscape impoundment is a body of reclaimed water which is used for aesthetic enjoyment or which otherwise serves a function not intended to include public contact.

(k) **Approved Laboratory Methods.** Approved laboratory methods are those specified in the latest edition of "Standard Methods for the Examination of Water and Wastewater", prepared and published jointly by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation and which are conducted in laboratories approved by the State Department of Health.

(l) **Unit Process.** Unit process means an individual stage in the wastewater treatment sequence which performs a major single treatment operation.

(m) **Primary Effluent.** Primary effluent is the effluent from a wastewater treatment process which provides removal of sewage solids so that it contains not more than 0.5 milliliter per liter per hour of settleable solids as determined by an approved laboratory method.

(n) **Oxidized Wastewater.** Oxidized wastewater means wastewater in which the organic matter has been stabilized, is nonputrescible, and contains dissolved oxygen.

(o) **Biological Treatment.** Biological treatment means methods of wastewater treatment in which bacterial or biochemical action is intensified as a means of producing an oxidized wastewater.

(p) **Secondary Sedimentation.** Secondary sedimentation means the removal by gravity of settleable solids remaining in the effluent after the biological treatment process.

(q) **Coagulated Wastewater.** Coagulated wastewater means oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated by the addition of suitable floc-forming chemicals or by an equally effective method.

(r) **Filtered Wastewater.** Filtered wastewater means an oxidized, coagulated, clarified wastewater which has been passed through natural undisturbed soils or filter media, such as sand or diatomaceous earth, so that the turbidity as determined by an approved laboratory method does not exceed an average operating turbidity of 2 turbidity units and does not exceed 5 turbidity units more than 5 percent of the time during any 24-hour period.

(s) **Disinfected Wastewater.** Disinfected wastewater means wastewater in which the pathogenic organisms have been destroyed by chemical, physical or biological means.

(t) **Multiple Units.** Multiple units means two or more units of a treatment process which operate in parallel and serve the same function.

(u) **Standby Unit Process.** A standby unit process is an alternate unit process or an equivalent alternative process which is maintained in operable condition and which is capable of providing comparable treatment for the entire design flow of the unit for which it is a substitute.

(v) **Power Source.** Power source means a source of supplying energy to operate unit processes.

(w) **Standby Power Source.** Standby power source means an automatically actuated self-starting alternate energy source maintained in immediately operable condition and of sufficient capacity to provide necessary service during failure of the normal power supply.

(x) **Standby Replacement Equipment.** Standby replacement equipment means reserve parts and equipment to replace broken-down or worn-out units which can be placed in operation within a 24-hour period.

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(y) **Standby Chlorinator.** A standby chlorinator means a duplicate chlorinator for reclamation plants having one chlorinator and a duplicate of the largest unit for plants having multiple chlorinator units.

(z) **Multiple Point Chlorination.** Multiple point chlorination means that chlorine will be applied simultaneously at the reclamation plant and at subsequent chlorination stations located at the use area and/or some intermediate point. It does not include chlorine application for odor control purposes.

(aa) **Alarm.** Alarm means an instrument or device which continuously monitors a specific function of a treatment process and automatically gives warning of an unsafe or undesirable condition by means of visual and audible signals.

(bb) **Person.** Person also includes any private entity, city, county, district, the State or any department or agency thereof.

NOTE: Authority cited: Section 208, Health and Safety Code and Section 13521, Water Code. Reference: Section 13521, Water Code.

History: 1. New Chapter 4 (§§ 60301–60357, not consecutive) filed 4-2-75; effective thirtieth day thereafter (Register 75, No. 14).

Article 2. Irrigation of Food Crops

60303. Spray Irrigation. Reclaimed water used for the spray irrigation of food crops shall be at all times an adequately disinfected, oxidized, coagulated, clarified, filtered wastewater. The wastewater shall be considered adequately disinfected if at some location in the treatment process the median number of coliform organisms does not exceed 2.2 per 100 milliliters and the number of coliform organisms does not exceed 23 per 100 milliliters in more than one sample within any 30-day period. The median value shall be determined from the bacteriological results of the last 7 days for which analyses have been completed.

60305. Surface Irrigation. (a) Reclaimed water used for surface irrigation of food crops shall be at all times an adequately disinfected, oxidized wastewater. The wastewater shall be considered adequately disinfected if at some location in the treatment process the median number of coliform organisms does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed.

(b) Orchards and vineyards may be surface irrigated with reclaimed water that has the quality at least equivalent to that of primary effluent provided that no fruit is harvested that has come in contact with the irrigating water or the ground.

60307. Exceptions. Exceptions to the quality requirements for reclaimed water used for irrigation of food crops may be considered by the State Department of Health on an individual case basis where the reclaimed water is to be used to irrigate a food crop which must undergo extensive commercial, physical or chemical processing sufficient to destroy pathogenic agents before it is suitable for human consumption.

Article 3. Irrigation of Fodder, Fiber, and Seed Crops

60309. **Fodder, Fiber, and Seed Crops.** Reclaimed water used for the surface or spray irrigation of fodder, fiber, and seed crops shall have a level of quality no less than that of primary effluent.

60311. **Pasture for Milking Animals.** Reclaimed water used for the irrigation of pasture to which milking cows or goats have access shall be at all times an adequately disinfected, oxidized wastewater. The wastewater shall be considered adequately disinfected if at some location in the treatment process the median number of coliform organisms does not exceed 23 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed.

Article 4. Landscape Irrigation

60313. **Landscape Irrigation.** Reclaimed water used for the irrigation of golf courses, cemeteries, lawns, parks, playgrounds, freeway landscapes, and landscapes in other areas where the public has access shall be at all times an adequately disinfected, oxidized wastewater. The wastewater shall be considered adequately disinfected if at some location in the treatment process the median number of coliform organisms does not exceed 23 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed.

Article 5. Recreational Impoundments

60315. **Nonrestricted Recreational Impoundment.** Reclaimed water used as a source of supply in a nonrestricted recreational impoundment shall be at all times an adequately disinfected, oxidized, coagulated, clarified, filtered wastewater. The wastewater shall be considered adequately disinfected if at some location in the treatment process the median number of coliform organisms does not exceed 2.2 per 100 milliliters and the number of coliform organisms does not exceed 23 per 100 milliliters in more than one sample within any 30-day period. The median value shall be determined from the bacteriological results of the last 7 days for which analyses have been completed.

60317. **Restricted Recreational Impoundment.** Reclaimed water used as a source of supply in a restricted recreational impoundment shall be at all times an adequately disinfected, oxidized wastewater. The wastewater shall be considered adequately disinfected if at some location in the treatment process the median number of coliform organisms does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed.

60319. **Landscape Impoundment.** Reclaimed water used as a source of supply in a landscape impoundment shall be at all times an adequately disinfected, oxidized wastewater. The wastewater shall be considered adequately disinfected if at some location in the treatment process the median number of coliform organisms does not exceed 23 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed.

Article 6. Sampling and Analysis

60321. **Sampling and Analysis.** (a) Samples for settleable solids and coliform bacteria, where required, shall be collected at least daily and at a time when wastewater characteristics are most demanding on the treatment facilities and disinfection procedures. Turbidity analysis, where required, shall be performed by a continuous recording turbidimeter.

(b) For uses requiring a level of quality no greater than that of primary effluent, samples shall be analyzed by an approved laboratory method of settleable solids.

(c) For uses requiring an adequately disinfected, oxidized wastewater, samples shall be analyzed by an approved laboratory method for coliform bacteria content.

(d) For uses requiring an adequately disinfected, oxidized, coagulated, clarified, filtered wastewater, samples shall be analyzed by approved laboratory methods for turbidity and coliform bacteria content.

Article 7. Engineering Report and Operational Requirements

60323. **Engineering Report.** (a) No person shall produce or supply reclaimed water for direct reuse from a proposed water reclamation plant unless he files an engineering report.

(b) The report shall be prepared by a properly qualified engineer registered in California and experienced in the field of wastewater treatment, and shall contain a description of the design of the proposed reclamation system. The report shall clearly indicate the means for compliance with these regulations and any other features specified by the regulatory agency.

(c) The report shall contain a contingency plan which will assure that no untreated or inadequately-treated wastewater will be delivered to the use area.

60325. **Personnel.** (a) Each reclamation plant shall be provided with a sufficient number of qualified personnel to operate the facility effectively so as to achieve the required level of treatment at all times.

(b) Qualified personnel shall be those meeting requirements established pursuant to Chapter 9 (commencing with Section 13625) of the Water Code.

60327. **Maintenance.** A preventive maintenance program shall be provided at each reclamation plant to ensure that all equipment is kept in a reliable operating condition.

60329. **Operating Records and Reports.** (a) Operating records shall be maintained at the reclamation plant or a central depository within the operating agency. These shall include: all analyses specified in the reclamation criteria; records of operational problems, plant and equipment breakdowns, and diversions to emergency storage or disposal; all corrective or preventive action taken.

(b) Process or equipment failures triggering an alarm shall be recorded and maintained as a separate record file. The recorded information shall include the time and cause of failure and corrective action taken.

(c) A monthly summary of operating records as specified under (a) of this section shall be filed monthly with the regulatory agency.

(d) Any discharge of untreated or partially treated wastewater to the use area, and the cessation of same, shall be reported immediately by telephone to the regulatory agency, the State Department of Health, and the local health officer.

60331. Bypass. There shall be no bypassing of untreated or partially treated wastewater from the reclamation plant or any intermediate unit processes to the point of use.

Article 8. General Requirements of Design

60333. Flexibility of Design. The design of process piping, equipment arrangement, and unit structures in the reclamation plant must allow for efficiency and convenience in operation and maintenance and provide flexibility of operation to permit the highest possible degree of treatment to be obtained under varying circumstances.

60335. Alarms. (a) Alarm devices required for various unit processes as specified in other sections of these regulations shall be installed to provide warning of:

(1) Loss of power from the normal power supply.
(2) Failure of a biological treatment process.
(3) Failure of a disinfection process.
(4) Failure of a coagulation process.
(5) Failure of a filtration process.
(6) Any other specific process failure for which warning is required by the regulatory agency.

(b) All required alarm devices shall be independent of the normal power supply of the reclamation plant.

(c) The person to be warned shall be the plant operator, superintendent, or any other responsible person designated by the management of the reclamation plant and capable of taking prompt corrective action.

(d) Individual alarm devices may be connected to a master alarm to sound at a location where it can be conveniently observed by the attendant. In case the reclamation plant is not attended full time, the alarm(s) shall be connected to sound at a police station, fire station or other full-time service unit with which arrangements have been made to alert the person in charge at times that the reclamation plant is unattended.

60337. Power Supply. The power supply shall be provided with one of the following reliability features:

(a) Alarm and standby power source.

(b) Alarm and automatically actuated short-term retention or disposal provisions as specified in Section 60341.

(c) Automatically actuated long-term storage or disposal provisions as specified in Section 60341.

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Article 9. Alternative Reliability Requirements for Uses Permitting Primary Effluent

60339. Primary Treatment. Reclamation plants producing reclaimed water exclusively for uses for which primary effluent is permitted shall be provided with one of the following reliability features:

(a) Multiple primary treatment units capable of producing primary effluent with one unit not in operation.

(b) Long-term storage or disposal provisions as specified in Section 60341.

Article 10. Alternative Reliability Requirements for Uses Requiring Oxidized, Disinfected Wastewater or Oxidized, Coagulated, Clarified, Filtered, Disinfected Wastewater

60341. Emergency Storage or Disposal. (a) Where short-term retention or disposal provisions are used as a reliability feature, these shall consist of facilities reserved for the purpose of storing or disposing of untreated or partially treated wastewater for at least a 24-hour period. The facilities shall include all the necessary diversion devices, provisions for odor control, conduits, and pumping and pump back equipment. All of the equipment other than the pump back equipment shall be either independent of the normal power supply or provided with a standby power source.

(b) Where long-term storage or disposal provisions are used as a reliability feature, these shall consist of ponds, reservoirs, percolation areas, downstream sewers leading to other treatment or disposal facilities or any other facilities reserved for the purpose of emergency storage or disposal of untreated or partially treated wastewater. These facilities shall be of sufficient capacity to provide disposal or storage of wastewater for at least 20 days, and shall include all the necessary diversion works, provisions for odor and nuisance control, conduits, and pumping and pump back equipment. All of the equipment other than the pump back equipment shall be either independent of the normal power supply or provided with a standby power source.

(c) Diversion to a less demanding reuse is an acceptable alternative to emergency disposal of partially treated wastewater provided that the quality of the partially treated wastewater is suitable for the less demanding reuse.

(d) Subject to prior approval by the regulatory agency, diversion to a discharge point which requires lesser quality of wastewater is an acceptable alternative to emergency disposal of partially treated wastewater.

(e) Automatically actuated short-term retention or disposal provisions and automatically actuated long-term storage or disposal provisions shall include, in addition to provisions of (a), (b), (c), or (d) of this section, all the necessary sensors, instruments, valves and other devices to enable fully automatic diversion of untreated or partially treated wastewater to approved emergency storage or disposal in the event of failure of a treatment process, and a manual reset to prevent automatic restart until the failure is corrected.

60343. Primary Treatment. All primary treatment unit processes shall be provided with one of the following reliability features:

(a) Multiple primary treatment units capable of producing primary effluent with one unit not in operation.

(b) Standby primary treatment unit process.

(c) Long-term storage or disposal provisions.

60345. Biological Treatment. All biological treatment unit processes shall be provided with one of the following reliability features:

(a) Alarm and multiple biological treatment units capable of producing oxidized wastewater with one unit not in operation.

(b) Alarm, short-term retention or disposal provisions, and standby replacement equipment.

(c) Alarm and long-term storage or disposal provisions.

(d) Automatically actuated long-term storage or disposal provisions.

60347. Secondary Sedimentation. All secondary sedimentation unit processes shall be provided with one of the following reliability features:

(a) Multiple sedimentation units capable of treating the entire flow with one unit not in operation.

(b) Standby sedimentation unit process.

(c) Long-term storage or disposal provisions.

60349. Coagulation.

(a) All coagulation unit processes shall be provided with the following mandatory features for uninterrupted coagulant feed:

(1) Standby feeders,
(2) Adequate chemical storage and conveyance facilities,
(3) Adequate reserve chemical supply, and
(4) Automatic dosage control.

(b) All coagulation unit processes shall be provided with one of the following reliability features:

(1) Alarm and multiple coagulation units capable of treating the entire flow with one unit not in operation;

(2) Alarm, short-term retention or disposal provisions, and standby replacement equipment;

(3) Alarm and long-term storage or disposal provisions;

(4) Automatically actuated long-term storage or disposal provisions; or

(5) Alarm and standby coagulation process.

60351. Filtration. All filtration unit processes shall be provided with one of the following reliability features:

(a) Alarm and multiple filter units capable of treating the entire flow with one unit not in operation.

(b) Alarm, short-term retention or disposal provisions and standby replacement equipment.

(c) Alarm and long-term storage or disposal provisions.

(d) Automatically actuated long-term storage or disposal provisions.

(e) Alarm and standby filtration unit process.

60353. Disinfection.

(a) All disinfection unit processes where chlorine is used as the disinfectant shall be provided with the following features for uninterrupted chlorine feed:

(1) Standby chlorine supply,
(2) Manifold systems to connect chlorine cylinders,
(3) Chlorine scales, and
(4) Automatic devices for switching to full chlorine cylinders.

Automatic residual control of chlorine dosage, automatic measuring and recording of chlorine residual, and hydraulic performance studies may also be required.

(b) All disinfection unit processes where chlorine is used as the disinfectant shall be provided with one of the following reliability features:

(1) Alarm and standby chlorinator;

(2) Alarm, short-term retention or disposal provisions, and standby replacement equipment;

(3) Alarm and long-term storage or disposal provisions;

(4) Automatically actuated long-term storage or disposal provisions; or

(5) Alarm and multiple point chlorination, each with independent power source, separate chlorinator, and separate chlorine supply.

60355. Other Alternatives to Reliability Requirements. Other alternatives to reliability requirements set forth in Articles 8 to 10 may be accepted if the applicant demonstrates to the satisfaction of the State Department of Health that the proposed alternative will assure an equal degree of reliability.

Article 11. Other Methods of Treatment

60357. Other Methods of Treatment. Methods of treatment other than those included in this chapter and their reliability features may be accepted if the applicant demonstrates to the satisfaction of the State Department of Health that the methods of treatment and reliability features will assure an equal degree of treatment and reliability.

The following guidelines have been published by the State Health Department to minimize the public health risks in irrigating with reclaimed wastewater. They are guidelines only and do not have the force of law, but are designed to aid irrigators who wish to reuse wastewater on crops or landscape.

STATE OF CALIFORNIA DEPARTMENT OF HEALTH

GUIDELINES FOR USE OF RECLAIMED WATER FOR SPRAY IRRIGATION OF CROPS

1. Reclaimed water shall meet the Regional Water Quality Control Board requirements and the quality requirements established by the State of California Department of Health for health protection.

2. The discharge shall be confined to the area designated and approved for disposal and reuse. Irrigation should be controlled to minimize ponding of wastewater and runoff should be contained and properly disposed.

3. Maximum attainable separation of reclaimed water lines and domestic water lines shall be practiced. Domestic and reclaimed water transmission and distribution mains shall conform to the "Separation and Construction Criteria" (see attached).

   a. The use area facilities must comply with the "Regulations Relating to Cross-Connections," Title 17, Chapter V, Sections 7583-7622, inclusive, California Administrative Code.

   b. Plans and specifications of the existing and proposed reclaimed water system and domestic water system shall be submitted to State and/or local health agencies for review and approval.

4. All reclaimed water valves and outlets should be appropriately tagged to warn the public that the water is not safe for drinking or direct contact.

5. All piping, valves, and outlets should be color-coded or otherwise marked to differentiate reclaimed water from domestic or other water.

   a. Where feasible, differential piping materials should be used to facilitate water system identification.

6. All reclaimed water valves and outlets should be of a type that can only be operated by authorized personnel.

7. Adequate means of notification shall be provided to inform the public that reclaimed water is being used. Conspicuous warning signs with proper wording of sufficient size to be clearly read shall be posted at adequate intervals around the use area.

8. Irrigation should be done so as to prevent or minimize contact by the public with the sprayed material and precautions should be taken to insure that reclaimed water will not be sprayed on walkways, passing vehicles, buildings, domestic water facilities, or areas not under control of the user.

   a. The irrigated areas should be fenced where primary effluent is used.

b. Windblown spray from the irrigation area should not reach areas accessible to the public.

c. Irrigated areas must be kept completely separated from domestic water wells and reservoirs. A minimum of 500 feet should be provided.

9. Adequate measures should be taken to prevent the breeding of flies, mosquitoes and other vectors of public health significance during the process of reuse.

10. Operation of the use area facilities should not create odors, slimes, or unsightly deposits of sewage origin.

11. Adequate time should be provided between the last irrigation and harvesting to allow the crops and soil to dry.

    a. Animals, especially milking animals, should not be allowed to graze on land irrigated with reclaimed water until it is thoroughly dry.

12. There should be no subsequent planting of produce on lands irrigated with primary effluent.

JC:gm
9/10/74

STATE OF CALIFORNIA DEPARTMENT OF HEALTH

GUIDELINES FOR USE OF RECLAIMED WATER FOR SURFACE IRRIGATION OF CROPS

1. Reclaimed water shall meet the Regional Water Quality Control Board requirements and the quality requirements established by the State of California Department of Health for health protection.

2. The discharge shall be confined to the area designated and approved for disposal and reuse. Irrigation should be controlled to minimize ponding of wastewater and runoff should be contained and properly disposed.

3. Maximum attainable separation of reclaimed water lines and domestic water lines shall be practiced. Domestic and reclaimed water transmission and distribution mains shall conform to the "Separation and Construction Criteria" (see attached).

    a. The use area facilities must comply with the "Regulations Relating to Cross-Connections," Title 17, Chapter V, Sections 7583-7622, inclusive, California Administrative Code.

    b. Plans and specifications of the existing and proposed reclaimed water system and domestic water system shall be submitted to State and/or local health agencies for review and approval.

4. All reclaimed water valves and outlets should be appropriately tagged to warn the public that the water is not safe for drinking or direct contact.

5. All piping, valves, and outlets should be color-coded or otherwise marked to differentiate reclaimed water from domestic or other water.

    a. Where feasible, differential piping materials should be used to facilitate water system identification.

6. All reclaimed water valves and outlets should be of a type that can only be operated by authorized personnel.

7. Adequate means of notification shall be provided to inform the public that reclaimed water is being used. Conspicuous warning signs with proper wording of sufficient size to be clearly read shall be posted at adequate intervals around the use area.

8. The public shall be effectively excluded from contact with the reclaimed water used for irrigation.

    a. The irrigated areas should be fenced where primary effluent is used.

b. Irrigated areas must be kept completely separated from domestic water wells and reservoirs. A minimum of 500 feet should be provided.

9. Adequate measures should be taken to prevent the breeding of flies, mosquitoes and other vectors of public health significance during the process of reuse.

10. Operation of the use area facilities should not create odors, slimes, or unsightly deposits of sewage origin.

11. Adequate time should be provided between the last irrigation and harvesting to allow the crops and soil to dry.

    a. Animals, especially milking animals, should not be allowed to graze on land irrigated with reclaimed water until it is thoroughly dry.

12. There should be no subsequent planting of produce on lands irrigated with primary effluent.

13. Adequate measures shall be taken to prevent any direct contact between the edible portion of the crops and the reclaimed water.

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STATE OF CALIFORNIA DEPARTMENT OF HEALTH

GUIDELINES FOR USE OF RECLAIMED WATER FOR LANDSCAPE IRRIGATION

1. Reclaimed water shall meet the Regional Water Quality Control Board requirements and the quality requirements established by the State of California Department of Health for health protection.

2. The discharge shall be confined to the area designated and approved for disposal and reuse. Irrigation should be controlled to minimize ponding of wastewater and runoff should be contained and properly disposed.

3. Maximum attainable separation of reclaimed water lines and domestic water lines shall be practiced. Domestic and reclaimed water transmission and distribution mains shall conform to the "Separation and Construction Criteria" (see attached).

    a. The use area facilities must comply with the "Regulations Relating to Cross-Connections," Title 17, Chapter V, Sections 7583-7622, inclusive, California Administrative Code.

    b. Plans and specifications of the existing and proposed reclaimed water system and domestic water system shall be submitted to State and/or local health agencies for review and approval.

4. All reclaimed water valves, outlets and/or sprinkler heads should be appropriately tagged to warn the public that the water is not safe for drinking or direct contact.

5. All piping, valves, and outlets should be color-coded or otherwise marked to differentiate reclaimed water from domestic or other water.

    a. Where feasible, differential piping materials should be used to facilitate water system identification.

6. All reclaimed water valves, outlets, and sprinkler heads should be of a type that can only be operated by authorized personnel.

    a. Where hose bibbs are present on domestic and reclaimed water lines, differential sizes should be established to preclude the interchange of hoses.

7. Adequate means of notification shall be provided to inform the public that reclaimed water is being used. Such notification should include the posting of conspicuous warning signs with proper wording of sufficient size to be clearly read. At golf courses, notices should also be printed on score cards and at all water hazards containing reclaimed water.

8. Tank trucks used for carrying or spraying reclaimed water should be appropriately identified to indicate such.

9. Irrigation should be done so as to prevent or minimize contact by the public with the sprayed material and precautions should be taken to insure that reclaimed water will not be sprayed on walkways, passing vehicles, buildings, picnic tables, domestic water facilities, or areas not under control of the user.

    a. Irrigation should be practiced during periods when the grounds will have maximum opportunity to dry before use by the public unless provisions are made to exclude the public from areas during and after spraying with reclaimed water.

    b. Windblown spray from the irrigation area should not reach areas accessible to the public.

    c. Irrigated areas must be kept completely separated from domestic water wells and reservoirs. A minimum of 500 feet should be provided.

    d. Drinking water fountains should be protected from direct or windblown reclaimed water spray.

10. Adequate measures should be taken to prevent the breeding of flies, mosquitoes and other vectors of public health significance during the process of reuse.

11. Operation of the use area facilities should not create odors, slimes, or unsightly deposits of sewage origin in places accessible to the public.

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STATE OF CALIFORNIA DEPARTMENT OF HEALTH

GUIDELINES FOR USE OF RECLAIMED WATER FOR IMPOUNDMENTS

1. Reclaimed water shall meet the Regional Water Quality Control Board requirements and the quality requirements established by the State of California Department of Health for health protection.

2. The discharge shall be confined to the area designated and approved for disposal and reuse. Runoff should be contained and properly disposed.

3. Maximum attainable separation of reclaimed water lines and domestic water lines shall be practiced. Domestic and reclaimed water transmission and distribution mains shall conform to the "Separation and Construction Criteria" (see attached).

    a. The use area facilities must comply with the "Regulations Relating to Cross-Connections," Title 17, Chapter V, Sections 7583-7622, inclusive, California Administrative Code.

    b. Plans and specifications of the existing and proposed reclaimed water system and domestic water system shall be submitted to State and/or local health agencies for review and approval.

4. At restricted recreational impoundments and landscape impoundments all valves and outlets should be appropriately tagged to warn the public that the water is not safe for drinking or bathing.

5. At non-restricted recreational impoundments all valves and outlets should be appropriately tagged to warn the public that the water is reclaimed from sewage and is not safe for drinking.

6. All piping, valves, and outlets should be color-coded or otherwise marked to differentiate reclaimed water from domestic or other water.

    a. Where feasible, differential piping materials should be used to facilitate water system identification.

7. All reclaimed water valves and outlets should be of a type that can only be operated by authorized personnel.

8. Adequate means of notification shall be provided to inform the public that reclaimed water is being used. Such notification should include the posting of conspicuous warning signs with proper wording of sufficient size to be clearly read.

9. Adequate measures shall be taken to prevent body-contact activities, such as wading or swimming, at restricted recreational impoundments containing reclaimed water.

10. Adequate measures shall be taken to prevent direct public contact with reclaimed water at landscape impoundments.

11. Restricted and non-restricted recreational impoundments shall be maintained under the continuous supervision of qualified personnel during periods of use.

12. Impoundments containing reclaimed water must be kept completely separated from domestic water wells and reservoirs. A minimum of 500 feet should be provided.

13. Adequate measures should be taken to prevent the breeding of flies, mosquitoes and other vectors of public health significance during the process of reuse.

14. Operation of the use area facilities should not create odors, slimes, or unsightly deposits of sewage origin in places accessible to the public.

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STATE OF CALIFORNIA DEPARTMENT OF HEALTH

GUIDELINES FOR WORKER PROTECTION AT WATER RECLAMATION USE AREAS

1. Employees should be made aware of the potential health hazards involved with contact or ingestion of reclaimed water.

2. Employees should be subjected to periodic medical examinations for intestinal diseases and to adequate immunization shots.

3. Adequate first aid kits should be available on location, and all cuts and abrasions should be treated promptly to prevent infection. A doctor should be consulted where infection is likely.

4. Precautionary measures should be taken to minimize direct contact of employees with reclaimed water.

    a. Employees should not be subjected to reclaimed water sprays.

    b. For work involving more than a casual contact with reclaimed water, employees should be provided with protective clothing.

    c. At crop irrigation sites, the crops and soil should be allowed to dry before harvesting by employees.

5. Provisions should be made for a supply of safe drinking water for employees. Where bottled water is used for drinking purposes, the water should be in contamination-proof containers and protected from contact with reclaimed water or dust.

    a. The water should be of a source approved by the local health authority.

6. Toilet and washing facilities should be provided.

7. Precautions should be taken to avoid contamination of food taken to areas irrigated with reclaimed water, and food should not be taken to areas still wet with reclaimed water.

8. Adequate means of notification shall be provided to inform the employees that reclaimed water is being used. Such notification should include the posting of conspicuous warning signs with proper wording of sufficient size to be clearly read.

    a. In some locations, especially at crop irrigation use areas, it is advisable to have the signs in Spanish as well as English.

9. All reclaimed water valves, outlets, and/or sprinkler heads should be appropriately tagged to warn employees that the water is not safe for drinking or direct contact (direct contact is allowed at non-restricted recreational impoundments).

10. All piping, valves and outlets should be color-coded or otherwise marked to differentiate reclaimed water from domestic or other water.

    a. Where feasible, differential piping materials should be used to facilitate water system identification.

11. All reclaimed water valves, outlets and sprinkler heads should be of a type that can only be operated by authorized personnel.

    a. Where hose bibbs are present on domestic and reclaimed water lines, differential sizes should be established to preclude the interchange of hoses.

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9/10/74

SEPARATION AND CONSTRUCTION CRITERIA
DOMESTIC AND RECLAIMED WASTEWATER TRANSMISSION AND DISTRIBUTION MAINS

BASIC SEPARATION		WATER MAIN INVOLVED		RECLAIMED WASTEWATER MAIN CONSTRUCTION MINIMUM SEPARATION IF BASIC SEPARATION IS NOT FEASIBLE		
Parallel Construction	Perpendicular Construction	Reclaimed Wastewater	Domestic Water	Parallel Construction	Perpendicular Construction Reclaimed wastewater main above domestic water main	Perpendicular Construction Reclaimed wastewater main below domestic water main Clearance less than three (3) feet
(a) 25'	(b) 3'	Pressure	(c) Gravity	No Exception	Minimum pipe class 2 x wwp; Steel casing 25' both sides of crossing	Minimum pipe class 2 x wwp; Steel casing 25' both sides of crossing
25'	3'	Gravity	Gravity	VCP, AC, CIP, or equal, class 150; 15' minimum separation; Mechanical compression joints	Steel casing 25' both sides of crossing	VCP, AC, CIP, or equal, class 150; Mechanical compression joints 25' both sides of crossing
10'	3'	Pressure	Pressure	Minimum pipe class 2 x wwp; 4' minimum separation; no common trench	Minimum pipe class 2 x wwp; Mechanical compression joints 4' both sides of crossing	Minimum pipe class 2 x wwp; Mechanical compression joints 4' both sides of crossing
10'	3'	Gravity	Pressure	VCP; Mechanical compression joints 4' minimum separation	Concrete encasement or steel casing 4' both sides of crossing	VCP, AC, CIP; Mechanical compression joints 4' both sides of crossing

(a) All distances measured from pipeline O.D.
(b) Domestic water main 3' above reclaimed wastewater main.
(c) Less than 5 psi.